AVIATION WEEK

MAR. 15, 1954

THIS ISSUE $1.00

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The Twenty-first Annual INVENTORY OF AIR POWER

New Airpower Doctrine

SPECIAL DELIVERY ... for strategic air power!

100 Complicated Math Problems-Per-Minute Are Solved For Him AUTOMATICALLY!

As jet-powered planes streak to new altitudes and speeds, they undergo split-second changes in temperature, pressure and moisture conditions. These changes create a flood of amazingly complex fuel metering problems. Adding to the complication are the pilot's changing demands from his engine.

Solving these fuel metering problems is equivalent to solving one hundred computations every 60 seconds! The Holley Turbine Control was developed to do the job.

Manufacturing the Holley Turbine Control required highly specialized skills, too. Working to extreme tolerances, Holley's manufacturing division has produced precision turbine controls for thousands of the nation's jet engines.

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VAN DYKE, MICHIGAN

LEADER IN THE DESIGN, DEVELOPMENT AND MANUFACTURE OF AVIATION FUEL METERING DEVICES

A—18

The news about pneumatics is that it is on the way to becoming the actuating power of the future. Gun chargers, emergency power actuating systems and other utility power applications developed by Kidde have already proved the vast potentialities of pneumatics in the field of aviation.

Aviation engineers are finding more and more uses for pneumatic power . . . a sign that the all-pneumatics aircraft may be just over the horizon.

Yet, for all the news it's making in aviation, pneumatics certainly isn't new. More than 250 years ago, Denis Papin compressed air by power from a water wheel. And in 1849, Baron Von Rathen proposed to compress air in stages with a series of intercoolers to get 750 pounds pressure for use in locomotives. Today, a Kidde compressor the size of a table radio will deliver 3000 PSI! Think what this means where weight is a factor...

Pneumatic systems for aircraft are light, simple and safe. The use of air insures an unlimited supply for the system, and eliminates the fire hazard. Pneumatic systems operate over a wide temperature range with exceptionally high energy delivery . . . can move huge loads quickly and easily.

We here at Kidde see a great future for pneumatics in aviation, and have been fortunate in being among the first to explore the applications of this exciting force. Perhaps you, too, are seeking new ways to apply this well-known energy source. If you have a problem in pneumatics, write us.

Kidde

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REX-FLEX flies with the new DC-7

Photos courtesy, Douglas Aircraft Company, Santa Monica, California

Anti-icing and cabin heater ducting of Douglas' newest transport protected with REX-FLEX connectors.

In the new Douglas DC-7—as in virtually every aircraft built in this country—Flexonics stainless steel assemblies play a part in vibration control. Flexible connectors for the cabin heating and anti-icing system are REX-FLEX corrugated stainless steel assemblies. These units are designed to isolate vibration and noise in rigid ducting and prevent its transfer to the air frame. Like all Flexonics products, these units are scientifically engineered to do their job right . . . proved in the extensive Flexonics labs before going into production . . . carefully fabricated under rigid quality control.

Experience and facilities second to none are your best assurance of getting exactly what you want when you specify Flexonics stainless steel ducting, hose, bellows and flexible connectors. For recommendations, send an outline of your requirements.

Upper circle—Rex-Flex Type RF-40 flexible connector in the anti-icing systems

Lower circle—Rex Flex Type RF-40 flexible connector in the cabin heating system.

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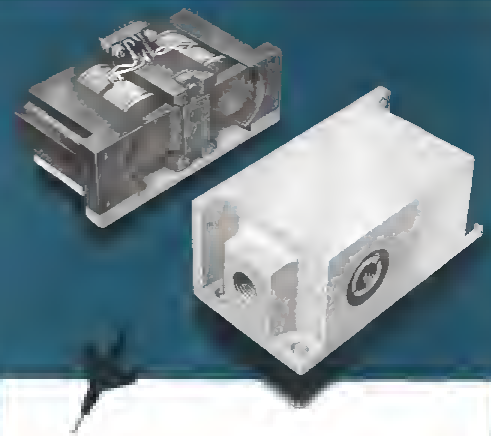

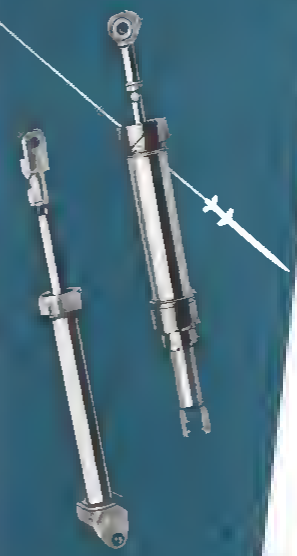

HYDRAULIC SERVOS FOR GUIDANCE SYSTEMS

The analysis of high performance hydraulic servos for guidance systems is very new. We feel, however, that we are "old timers" in supplying the building experience and engineering "know-how".

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Our experienced engineers are available to assist you in the development of hydraulic servo systems for every application. And we have the manufacturing, inspection and testing facilities to maintain a high degree of quality and dimensional control in meeting prototype or production schedules.

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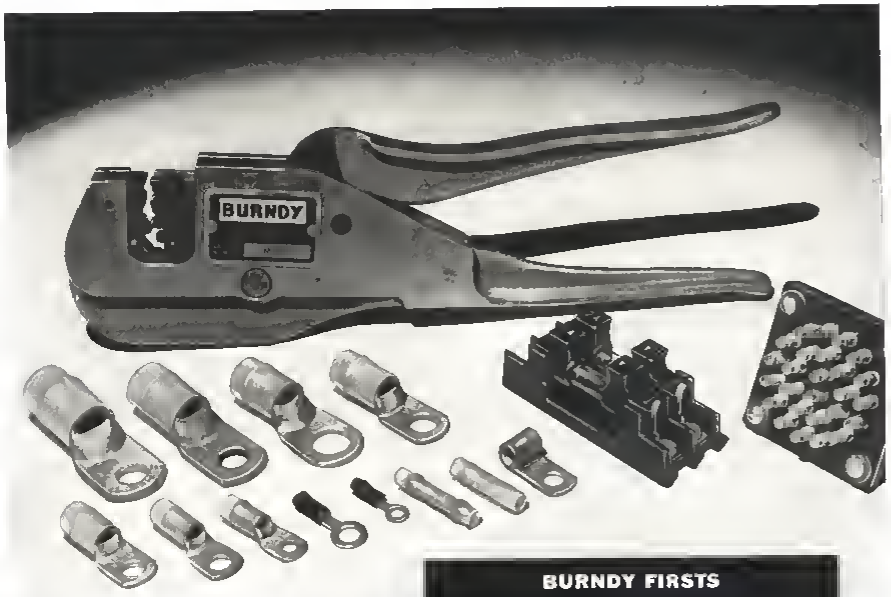


FIRST

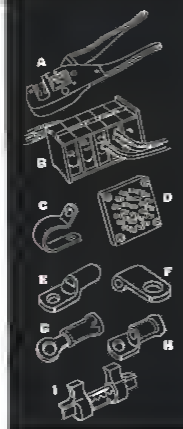
FOR MAXIMUM CIRCUIT SAFETY

YESTERDAY —Many of the most important technical improvements in aircraft electrical harness systems were originated by Burndy engineers working closely with the aircraft industry.

TODAY —Burndy terminals, current limiters and disconnect panels are specified for use in nearly every modern aircraft, military and commercial.

TOMORROW —Products now under development at Burndy will help make future planes still faster, lighter, safer.

BURNDY FIRSTS



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B—Crablok multiple disconnect terminal strip Bull. CB50

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(Write Aircraft Products Division for specific bulletin)

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53-25

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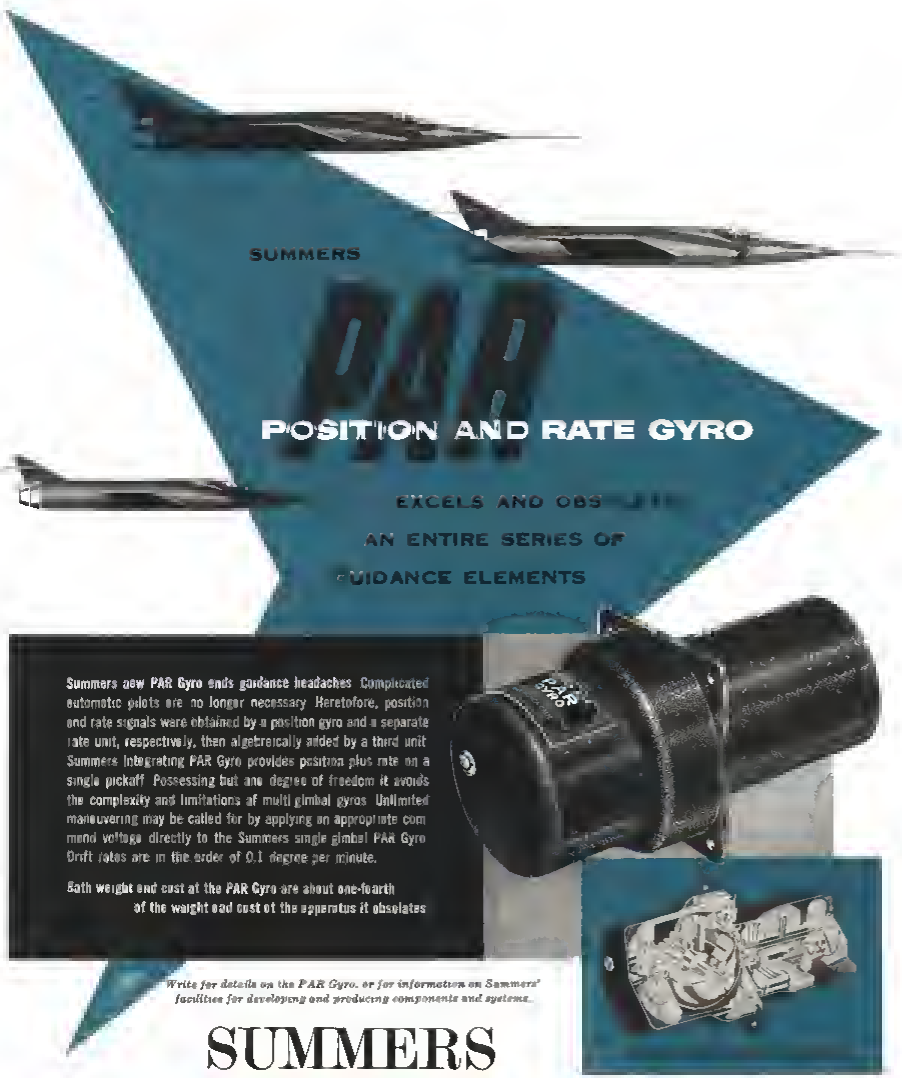

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To the layman, the pinpointing of a destination for a guided missile is still pure magic. But to the engineer, the control and guidance of rockets and guided missiles in flight simply means another application for STRATOPOWER quality and advanced design.

The unerring performance of STRATOPOWER Pumps has been demonstrated times without number down through the years. At sea level and at heights still to be achieved these perfect examples of precision engineering provide the fluid power that positively answers the question of weight vs. horsepower as well as the equally important requirement of long-lived dependability.

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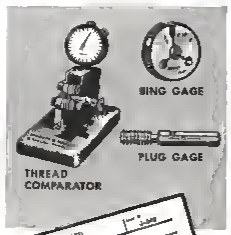
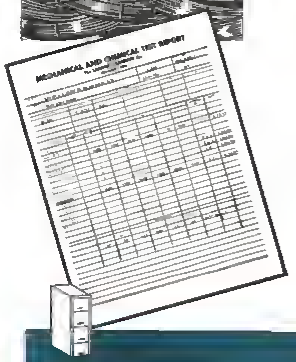
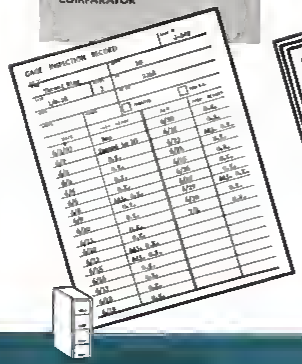
Systematic gage control by periodic checks with gage masters guarantees quality throughout every phase of production and sampling.

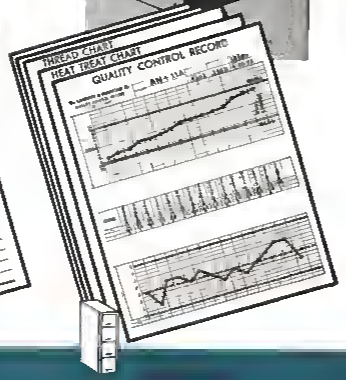


PROCESS CONTROL

In process, quality is checked by Shewhart Control Charts of ($\bar{X}$ R, p, c, I, etc.) These charts guarantee the control of quality and products 'in tolerance'.



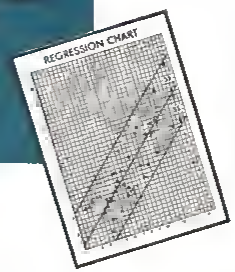




This reservoir of information is invaluable for statistical analyses and management reports.

Studies of these records determine process averages, machine capacities, quality trends, tool and die life,

heat treat analyses. Special statistical techniques are: Correlation, Analysis of Variance and Significance Tests.



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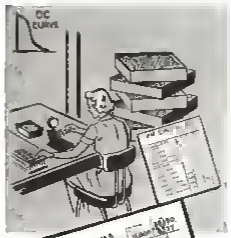

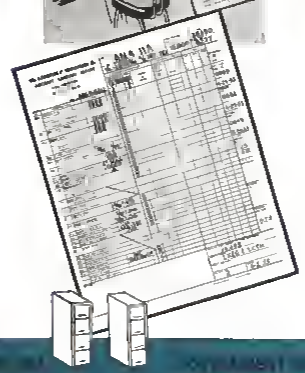

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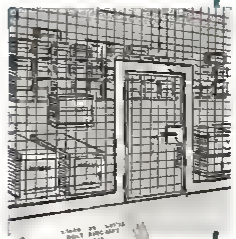

LAMSON AIRCRAFT FASTENERS

BOLTS

Aircraft, AN3 to AN20
Clevis, AN21 to AN36
Aircraft, Drilled Head, AN73 to AN81, AN73A to AN81A
Aircraft, Close Tolerance, AN173 to AN186
Hex Head, AN101001 to AN101900
Hex Head Drilled Shank, AN101901 to AN102800
Drilled Hex Head, AN102801 to AN103700
Drilled Hex Head, 6 Holes, AN103701 to AN104600

NUTS

Castellated, Airframe AN310
Plain, Airframe, AN315
Check, AN316
Plain Hex (Fine Thd.), 325
Castle (S. A. E.), 330
Plain Hex (Coarse Thread), AN335
Light Hexagon (Coarse Thread—Fine Thread), AN340—AN345
Engine—Slotted, AN355
Plain Engine, AN360

PINS

Cotter, AN380
Cotter (Corrosion Resisting Steel), AN381
Flat Head, AN392 to AN406

SCREWS—Slotted

Fillister Head (Coarse Thread—Fine Thread), AN500—AN501
Fillister Head (Drilled Head) (Coarse Thd.—Fine Thd.), AN500A—AN501A
Drilled Fillister Head Machine (Fine Thd.—Coarse Thd.) AN502—AN503
Machine, Round Head (Coarse Thread—Fine Thread), AN515—AN520
Washer Head, AN525
Machine, Truss Head, AN526
Sheet Metal Round Head, AN530

SCREWS—Phillips Recessed

Machine, Flat Head, 82° (Coarse Thd.—Fine Thd.), AN505—AN510
Machine, Round Head (Coarse Thd.—Fine Thd.), AN515—AN520
Machine, Truss Head, AN526
Machine, Flat Head, 100°, AN507
100° Flat Head (Structural), AN509
Brazier Head, NAS220 to NAS224
Sheet Metal Round Head, AN530
Sheet Metal Flat Head, AN531
100° Flat Head, Alloy Steel, CT205 to CT208

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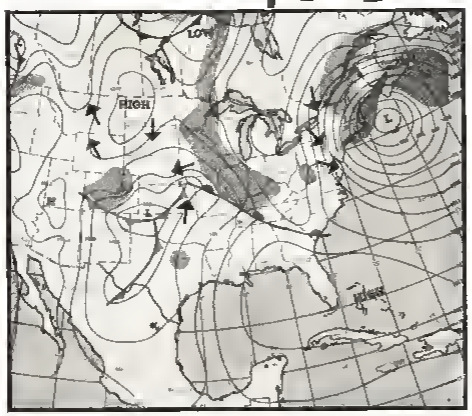
These weather items prepared in consultation with the United States Weather Bureau

ALLOW EXTRA MARGIN of air speed when landing in the vicinity of thunderstorms because of sudden wind shifts and gusts. Rapid shifts often accompany the cold downdrafts just ahead of the storm

WINDS ALOFT usually differ greatly from surface winds. Check the U. S. Weather Bureau's Winds Aloft Analyses, issued 4 times daily and distributed on aviation teletypewriter circuits

REMEMRER—Airport Towers report landing wind direction in degrees magnetic, like runways. On weather reports, however, wind direction is always with reference to true north. Over 20° difference in some parts of U. S.



AS SHOWN ON MAP, winds blow nearly parallel to isobars—the closer the isobars, the stronger the winds. When facing the wind, high pressure lies to left and low pressure to right. (Northern Hemisphere)

FAST-SHIFTING winds call for quick engine response at a moment's notice. That's why wise pilots protect power and performance with the very best fuels and lubricants—Mobilgas Aircraft and Mobiloil Aero.

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TWO PHOTOS LEFT HAP ABOVE COURTESY U. S. WEATHER BUREAU

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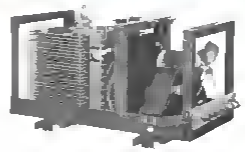

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- **Ripple:** 5% maximum ■ **Weight:** 19 pounds
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it's the extra margin of safety that counts!

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Bonded Insulation: Here is insulation that stays put because it's BONDED—does not rely on crimping action alone to maintain protection. **Insulation Support:** AMP PRE-INSULATED DIAMOND GRIP® TERMINALS have double support action over the critical junction area of wire and terminal barrel. Both inner copper sleeve and bonded insulation sleeve help prevent sharp wire bends and frayed insulation. 3 special tool adjustments insure positive grip over wide range of insulation diameters. **Controlled Installation Tooling:** AMP *CERTI-CRIMP*® HAND TOOLS are designed to make every terminal application never too tight and always tight enough. This exacting, pre-determined crimp is the secret of AMP'S outstanding performance. Jaw dies (gauged to ± .003) close with exactness every time, and the same control and precision is obtainable whenever you use AMP hand tools or AMP automatic machines! **Dot and Color Coding!** *AMP PRE-INSULATED DIAMOND GRIP*® TERMINALS AND TOOLS are color matched to insure proper combination. AMP dot coding "brands" each application so you know that the right team has been used together. **Speed of Application:** AMP AUTOMATIC WIRE TERMINATORS will help keep your wire preparation up to schedule. 1200 to 1800 PRE-INSULATED® type terminations per hour are not unusual with these machines!

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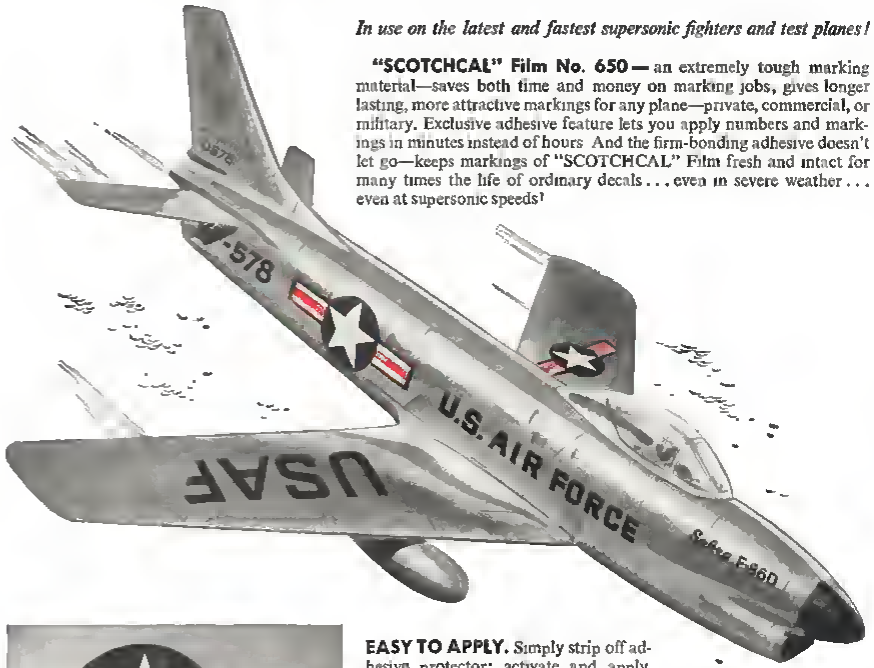

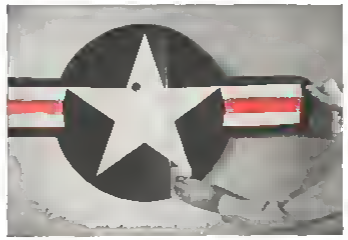

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COLLINS 242F-3 GROUND STATION TRANSMITTER
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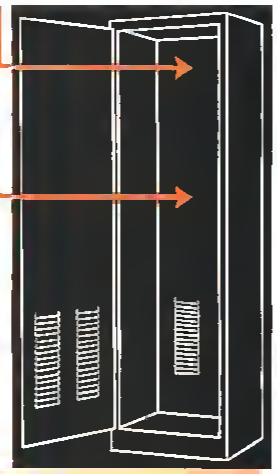
108 to 152 mc. Rated at 50 watts RF output into 52 ohms. Normally supplied with power supply/modulator unit and one RF unit. Extra RF units (for non-simultaneous operation) can be added as required to a common power supply/modulator. Each RF unit has provision for two crystals and is equipped with a selector switch allowing a pair of channel frequencies up to 0.3% separation without retuning. Up to four RF units (eight channel frequencies) can be remotely operated by the Type 278E-1 Remote Control Unit. An unlimited number of RF units can be locally controlled. All units designed for 19" rack mounting. Power requirements: 115/230 volts, 50/60 cps, single phase. 800 watts transmit, 100 watts standby.

RF UNIT — Tubes, transformers, and controls are accessible from the front. Under-chassis wiring is accessible from the rear by the removal of the protective cover. Vertical type chassis construction is employed with the tubes and transformers mounted horizontally. There is a sub-chassis for the oscillator, frequency multiplier and driver, and a sub-assembly for the final amplifier. This type of construction allows nearly ideal heat dissipation thus providing cooler running equipment for longer service life.

POWER SUPPLY/MODULATOR — As in the RF unit, tubes and controls are accessible from the front. Under-chassis wiring is accessible from the rear after removal of the protective cover. Vertical type chassis construction is employed with tubes and transformers mounted horizontally.



S1M-7 VHF RECEIVER — COMPANION to 242F Transmitters

Frequency Range. 118.0 to 152.0 mc.
Sensitivity. Signal to noise ratio for a 5 microvolt input signal modulated 30% is not less than 10 db.*
Selectivity. Bandwidth at 6 db attenuation is not less than 45 kc. Bandwidth at 60 db attenuation is not more than 140 kc.
Automatic Volume Control. Audio output will not vary more than 3 db when the input signal is varied from 5 to 100,000 microvolts.
Input Circuit. Impedance 52 ohms unbalanced.
Output Circuit. Impedance 600 ohms split secondary winding with 4 ohm tap for speaker voice coil operation.
Output Level. Not less than 2.0 watts for 5 microvolt input signal modulated 30% at 1000 cps.
Audio Frequency Response. Audio output from 300 to 3500 cps does not vary more than 3 db from audio output at 1000 cps.
Audio Distortion. Does not exceed 10% when measured at 2.0 watts output with signal modulated 30% at 1000 cps.
Spurious Response. All spurious responses are attenuated at least 90 db with respect to desired signal.
Ambient Temperature Range. —40°C to +60°C.
Ambient Humidity Range. 0 to 95% relative humidity.
Altitude. Sea level to 10,000 feet.
Frequency Stability. 0.005% over the specified service conditions.
Power Source. 115 v or 230 v, 50-60 single-phase a-c.
Dimensions. Width 19", height 8¾", depth 10¾".
Weight. Approx. 26 lbs.

*Input signals specified are signal voltages in series with 52 ohms, measured with open circuit.

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FOR EXTRA POWER
200 WATT 242F-2 Transmitter

Ambient Temperature Range. —40°C to +60°C.
Ambient Humidity Range. 0 to 90% relative humidity.
Altitude. Sea level up to 7000 feet.
Power Source. The unit operates from 105/115/210-230 v ac 50/60 cycles, single phase with a standby power requirement of 200 watts and a transmit power requirement of 1300 watts. It operates with a power factor of 90% lagging. The unit can be operated from 115 v ac with two primary windings on transformer connected in parallel or on 230 v ac with these windings in series. Low voltage taps are also provided on all transformers.
Frequency Range. 108 to 152 megacycles.
Channels. Single channel transmitter with desired output frequency determined by crystal frequency selection. A second frequency can be installed without retuning with the requirement that the channel separation shall not be more than 0.3% of operating frequency. This spacing will reduce power no greater than 0.5 db.
Frequency Stability. ± 0.001%.
Harmonics and Other Spurious Production. All spurious radiation, including harmonics, are at least 80 db below carrier level when used with the 35D-1 filter supplied with transmitter.
Audio Input. 100 ohm carbon microphone with push-to-talk switch or a high impedance dynamic microphone with push-to-talk switch. Dynamic microphone is recommended because of superior frequency response.
Modulation. At least 90% modulation is obtained from 300 to 3750 cps or 300 to 10,000 cps depending on application.
Audio Frequency Response. Flat to ± 3 db with respect to 1000 cps over a range of 300 to 3750 cps. This is measured at a level for 90% modulation without clipping.
Power Output. At least 200 watts is delivered over frequency limit and service conditions when operating into a 52 ohm resistive load.
Carrier Shift. Power output decreases less than 10% over the range of 0 to 90% modulation.
Output Impedance. 52 ohms.
Noise Level. Better than 40 db below 90% modulation without clipping.
RF Unit. 19" wide, 12¼" high and 12" deep.
Modulator Unit. 19" wide, 14" high and 12" deep.
RF Selector Unit. 19" wide, 7" high and 8" deep.
Filter and Bias Unit. 19" wide, 10½" high and 12" deep.

50 WATT 242F-3
VHF Ground-Station Transmitter

Ambient Temperature Range. —40°C to +60°C.
Ambient Humidity Range. 0 to 90% relative humidity.
Altitude. Sea level up to 7000 ft.
Power Source. The unit operates from 105/115/210-230 v ac, 50/60 cycles, single phase with a standby power of 100 watts and a full load transmit power requirement of 800 watts. It operates at a power factor of 90% lagging. The unit can be operated from 115 v ac with two primary windings on the transformer connected in parallel or on 230 v ac with these windings in series.
Frequency Range. 108 to 152 megacycles.
Channels. This is a single channel transmitter with desired output frequency determined by crystal frequency selection. A second channel is provided with the requirement that the channel separation shall not be more than 0.3% of operating frequency, without retuning.
Frequency Stability. The crystals utilized are mounted in a temperature stabilized oven so that a frequency stability of ± 0.001% is obtained under any natural combination of the service conditions.
Harmonics and Other Spurious Production. All spurious radiation, including harmonics, are at least 80 db below carrier level when used with the 35D-1 filter supplied with transmitter.
Modulation. High level amplitude modulation is obtained through use of a plate and screen modulation transformer. 90% modulation is obtained from 300 to 3750 cps, or 10,000 cps depending on application.
Power Output. At least 50 watts is delivered over frequency limit and service conditions when operating into a 52 ohms resistive load.
Carrier Shift. Less than 10%.
Output Impedance. 52 ohm.
Audio Input. A microphone input circuit is designed to operate from a carbon microphone or a dynamic high impedance microphone. A 600 ohm balanced audio line is also provided for remote operation.
Audio Frequency Response. The audio frequency response of the unit is flat to ± 3 db with respect to 1000 cps over a range of 300 to 3750 cps.
Audio Frequency Distortion. The audio frequency distortion is less than 10% with a modulation level of 90%.
Noise Level. Better than —40 db.

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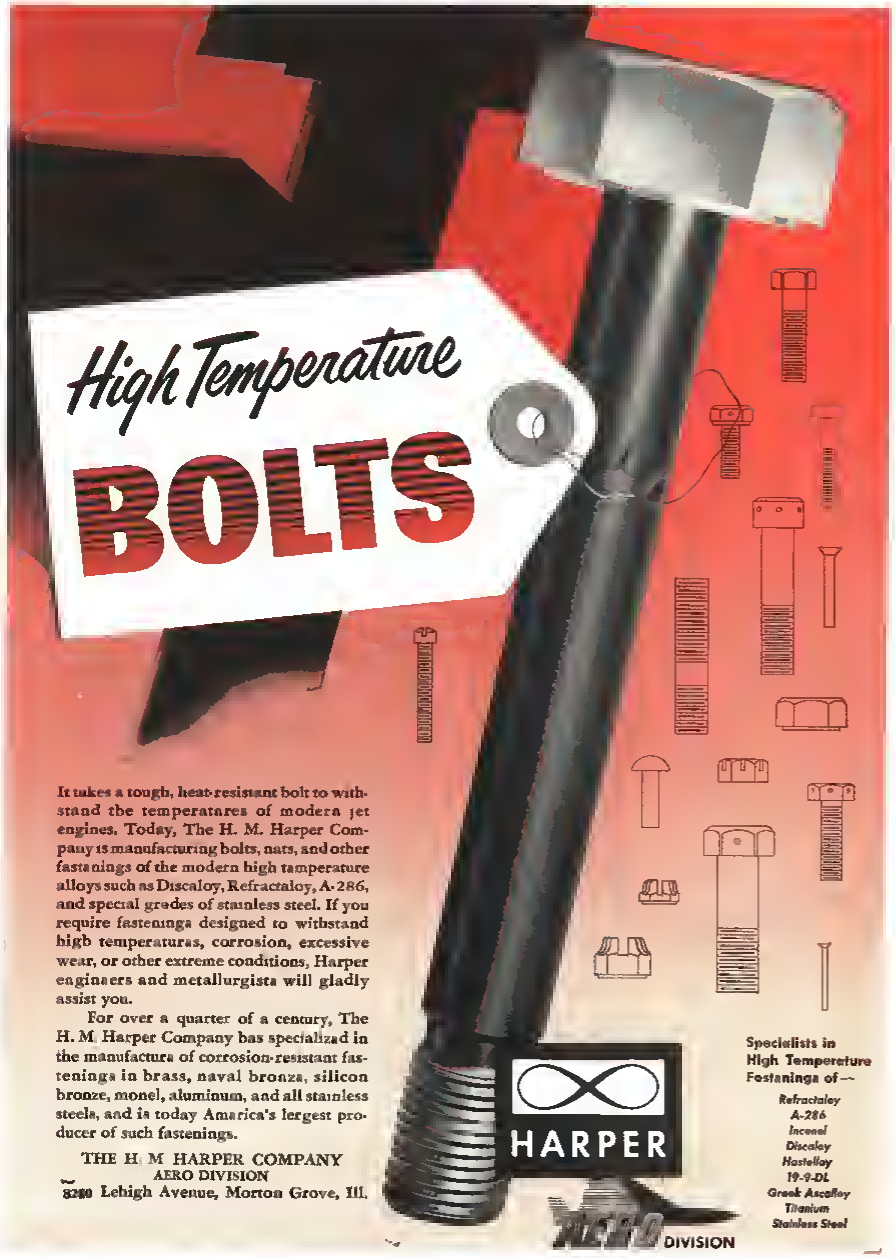

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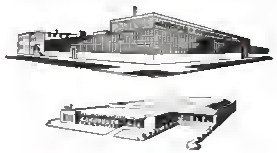

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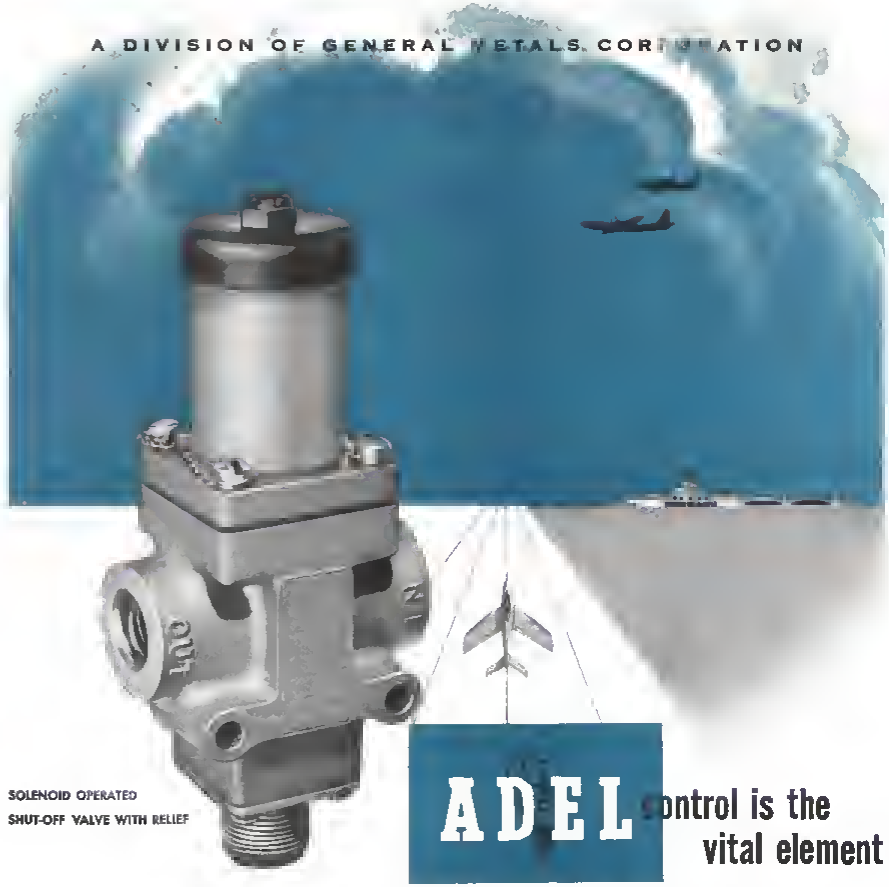

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custom-engineered or standard types for a wide range of control needs on today's complex aircraft and missiles

Since the early Thirties, Barber-Colman Company has been designing and manufacturing controls specifically for aircraft applications.

Throughout the most important period in aviation's advancement, Barber-Colman engineers have closely co-operated with major airframe and equipment manufacturers, the military, and all leading airlines. As a result they have acquired a thorough and very special knowledge of those factors in aircraft design which determine and limit the function, size, weight, *and performance* of accessory equipment.

Applications for Barber-Colman aircraft controls range from basic remote positioning to sequence operation of complex air conditioning systems . . . with either custom-engineered or standard type controls as required by the specific applications involved.

TEMPERATURE CONTROLS
Illustrated is Barber-Colman's latest electronic control assembly. For use in a jet fighter, it incorporates relay and amplifier unit, selector control, and override switches in one panel-mounted assembly. Barber-Colman offers complete coverage of the automatic temperature control field—electric, electronic, cycling, proportioning.

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Small permanent-magnet and split-series d-c motors with true electrical balance, 25% higher efficiency, superior commutation, exceptionally low radio noise, and outstanding constructional features. Gear head versions offer wide selection of gear ratios.

VALVES
Barber-Colman offers a wide variety of electrically actuated air valves for use with temperature and pressure control applications. This dual 2" valve assembly solved a difficult mounting problem.

ACTUATORS
Rotary and linear types. These Barber-Colman actuators combine gear reductions, switching, mounting details, and other design features to meet most aircraft applications in their field-speed class.

POSITIONING CONTROLS
Completely integrated high-speed positioning control systems including all transmitting, rheostat, d-c servoelectronic control box, and remote actuator. Unique circuitry provides anti-hunt feature.

THERMO-SENSITIVE ELEMENTS
Complete line of thermo-sensitive wire and thermistor-sealing elements. New ceramic duct element provides solution to environmental extremes encountered in jet aircraft. Extremely fast response withstands 800° F.

ULTRA-SENSITIVE RELAYS—Available in sensitivities from 50 microwatts to 1 milliwatt. Wide range of coils, enclosures, mounting details. Extensively used in balance detecting bridge circuits and as plate current relays in electronic applications. New type MVO offers savings in chassis mounting space.

Typical applications for Barber-Colman aircraft controls are: temperature control of cabin, cockpit, cargo, camera and electronic compartments . . . hot air or electrically heated windshields . . . wing and empennage anti-icing, and carburetor air . . . positioning of trim tabs, valves, throttles . . . flap unbalance detection . . . nose wheel steering . . . and hundreds of other applications. For data on Barber-Colman aircraft controls, write for Catalog F4141. Engineering sales offices in Los Angeles, Seattle, Baltimore, New York, Montreal.

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AVIATION WEEK

Volume 60 No 11
March 15, 1954

TWENTY-FIRST ANNUAL "INVENTORY OF AIRPOWER"

AVIATION WEEK
A McGRAW-HILL PUBLICATION

Industry Will Maintain Peak...

This will be another good year for aviation. Sales volume for manufacturers of airframes, engines, parts and accessories will climb about 10% over the postwar record $9-billion sales total for 1953. Major trunk airlines will boost gross revenues and net incomes but trouble looms ahead for local service lines and nonscheduled operators.

The electronics industry sold $3 billion worth of military equipment in 1953, mostly avionics. This year will see further expansion of both military and commercial avionics markets. Guided missiles development and manufacturing, already approaching the rank of a billion-dollar industry, will operate at about its 1953 level for the foreseeable future. No really large-scale production of missiles is in sight until major development obstacles are hurdled.

COMMERCIAL MARKET

HELICOPTER MANUFACTURING and operations will expand during 1954 with increasing emphasis on commercial products. Both the 30-40-passenger transport helicopters and the smaller 4-6-place designs aimed at a variety of industrial and agricultural applications will enter the commercial market during 1954.

Utility aircraft production should remain steady at a 4,000-plane level during 1954. Main effort will be devoted to twin-engine equipment aimed at the expanding business flying market. Most of these trends should carry into 1955.

THE NEW DOCTRINE

KEY TO THE FUTURE of the aviation market, at least for the next three years, is the new airpower doctrine formulated during the closing months of 1953 by the National Security Council and endorsed by President Eisenhower. It is the blueprint for both military and civil aviation policy during the three remaining years of the President's current term. Its military application resulted in the "new look" for U. S. strategic policy now being implemented by the Defense Department. Details of the new doctrine's civil application are now being studied by the Air Coordinating Committee in preparation of a detailed policy to be submitted to President Eisenhower. From the committee's study will emerge a new civil aviation policy to match its military counterpart.

The new strategic doctrine calls for building and maintaining two specific types of military forces. First, a force capable of swift and devastating retaliation for any major aggression. Second, mobile task forces that can function as a military "fire department" hurrying to any point on the globe to extinguish minor aggression.

DEVASTATING RETALIATION

AIRPOWER WILL DOMINATE both types of forces. For the swift and devastating retaliation deep in the enemy's heartland, the new defense doctrine will rely on atomic and hydrogen weapons delivered by the long-range bombers of the Air Force's Strategic Air Command. For the fire department task forces, airpower is required to provide the mobility to rush them to the scene of the emergency and the heavy punch necessary to blast out the fire.

The National Security Council has made it clear both to the Defense Department and to foreign nations that U. S. airpower will use atomic weapons against military targets to counter any type of future aggression. It is apparent that top policy makers have learned a lesson from the failure to use tactical atomic weapons against the Chinese Communist armies during the early phases of their aggression in Korea.

ADM. ARTHUR W. RADFORD, chairman of the Joint Chiefs of Staff, also has made it clear that any discussions on maintaining superior United States airpower are based on a concept of national airpower that includes not only military aviation of the Air Force, Navy, Army and Marines, but also civil aviation resources such as the commercial airlines and the aircraft manufacturing industry.

This strategic doctrine is a new concept and its implementation in regard to airpower has only begun. First effects on our national airpower have been good. The Air Force will continue its expansion program toward a goal of 137 combat wings and an active inventory of some 22,000 modern aircraft by 1957. Naval aviation will maintain its combat strength of 16 carrier air groups plus supporting anti-submarine, patrol and transport squadrons to achieve an inventory of 9,000 modern aircraft by 1957. Army will continue its expansion of airpower to exploit the mobility of vertical envelopment. Marines will maintain three modern air wings plus a helicopter fleet for an assault.

"Today there is no argument among military planners as to the importance of airpower. Offensively, defensively and in support of other forces it is a primary requirement. Its strength continues to grow, both through increases in combat units and through better equipment. . . .

"The President of the United States, the Secretary of Defense, and the Joint Chiefs of Staff are of one mind on this matter. This nation will maintain a national airpower superior to that of any other nation in the world."

—Admiral Arthur W. Radford, USN, Chairman, Joint Chiefs of Staff

THE MOST SERIOUS WEAKNESS apparent so far in the military implementation of the new strategic doctrine is the lack of sufficient air transport to provide the Army with the long-range mobility it must have to do a more effective job with fewer men. However, a major reorganization of military air transport has been boiling in the Pentagon and this may solve this critical airlift problem soon.

'AGE OF PERIL'

UNDER THE NEW STRATEGIC DOCTRINE United States military strength is being built primarily around atomic and hydrogen weapons and the speed of jet aircraft for delivery to the enemy. Older and more traditional armaments of surface forces on land and sea are being curtailed as the air is exploited. Defense Secretary Charles E. Wilson has indicated that airpower will claim a larger percentage of the defense budget in the future.

In addition to this shift in emphasis on the character of U. S. military strength, the new strategic doctrine also changed its tempo. A long-range program has been set on maintaining and modernizing adequate military forces to meet the continuing crises of what President Eisenhower has termed "an age of peril." This is in contrast to the frantic mobilization of the Korean period to meet a "moment of crisis."

If properly implemented this change of tempo will bring the aircraft industry closer to its long-sought goal of a stabilized long-term procurement program as a substitute for the sharp peaks and deep valleys that have marked the past 20 years. It also will bring the taxpayers closer to their goal of obtaining adequate national airpower at a reasonable cost.

JOB FOR THE FUTURE

THE FUTURE OF AMERICAN AIRPOWER has been brightened considerably by the new strategic doctrine, but it still leaves many problems looming for both the aircraft manufacturers and the airlines. According to present plans, the manufacturing industry should stabilize in 1956 at a rate of about 5,000 new military planes annually plus a considerable maintenance and modification workload on military airpower already in being. The airlines will probably be given a real stake in operating many phases of the military airlift required by the new strategic doctrine.

IF THE PROMISE of the new airpower doctrine is to be converted into the reality of a national airpower that is truly second to none, a concerted effort will be required by all segments of the aircraft industry and all government officials whose responsibilities concern aviation development. This effort should be aimed at hammering home to the public and their elected representatives in Congress the problems in achieving the quantity and quality of airpower that is necessary for survival.

ROBERT HOTZ

Color Portfolio Of New Military, Research Planes

BOEING YB-52
Stratofortress

REPUBLIC F-84F
Thunderstreak

DOUGLAS F4D
Skyray

BOEING B-47
Stratojet

McDONNELL F3H
Demon

DOUGLAS A3D

■ left

NORTH AMERICAN F-100
Super Sabre

DOUGLAS D-558 II
Skyrocket

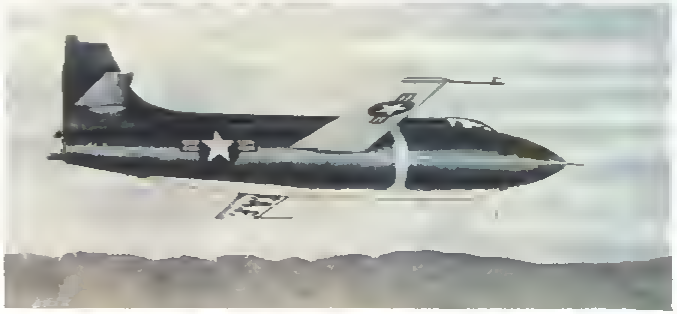
CHANCE VOUGHT REGULUS

■ right

DOUGLAS X-3

BELL X-1A

CONVAIR XF2Y
Sea Dart



STRIKING POWER of Strategic Air Command will be strengthened by addition of long-range, highspeed Boeing B-52 Stratofortress

Air Force Takes Key Role in U.S. Policy

New doctrine recognizes the revolution in military methods stemming from development of atomic weapons and highspeed, long-range aircraft.

By Robert Hotz

The Air Force is rapidly becoming the dominant factor in United States military strategy. The new strategic doctrine of the Eisenhower administration, for the first time in American history fully recognizes the revolution in military methods wrought by the combination of atomic weapons with high-speed, long-range aircraft. As a result USAF now occupies a position as an instrument of national policy similar to that of the British Navy in the British Empire of the 19th century.

There is heartening evidence both within USAF, where a more mature type of leadership is growing fast, and externally among top Administration policy-makers and members of Congress that the full implications of this vital relationship between the quantity and quality of American airpower and the success of American policy is becoming more clearly understood.

The fiscal 1955 budget represented a definite break with the postwar "balanced forces" concept that divided the Defense Department budget in an even three-way split among the services. The fiscal 1955 budget allots USAF about 40% of the total Defense Department money.

Defense Secretary Charles E. Wilson has indicated that this percentage will increase in future military budgets. There are still some voices crying out from the Pentagon labyrinth for a return to the traditional and "more moral" methods of waging war but these outcries are diminishing both in volume and frequency.

► **The Road Back**—During 1954 USAF will be nearing the end of a long and frenzied effort to reach the quantitative and qualitative level of airpower necessary to cope with the requirements of the new national policy. For the first time since its demobilization after World War II, USAF will be close to a state of genuine combat readiness in relation to its potential opponents.

In 1949, the year before the Korean war began, USAF was a skeleton of 42 combat wings equipped mostly with World War II surplus aircraft that were obsolescent even then. By mid-summer this year, USAF will reach a strength of 115 combat wings. Total plane strength will have increased from 20,000 in 1949 to 22,000.

At the same time USAF was expanding to a 140% increase in its combat strength, it was also wrestling with the conversion from war surplus and early vintage jet equipment to modern transonic aircraft.

In place of the piston-powered F-51s and 500 mph straight wing F-80 jets of 1949, USAF fighter squadrons now have 700 mph sweptwing Sabres and will soon get supersonic F-100 Super Sabres. The Air Force's all weather capability has progressed from slow and ineffectual F-82 Twin Mustangs to stable of jet-powered, radar equipped and rocket-firing interceptors such as the F-89D Scorpion, the F-94C Starfire and the F-86D. Production is already beginning on the Convair F-102 supersonic delta wing all weather interceptor.

Light bomber units that went to war in Korea equipped with piston-engine B-26 bombers will soon get B-57A twin jet bombers equipped to carry atomic weapons. Strategic Air Command crews who fought MiG-15s in Korea with B-29s have traded their old Superfortresses for sweptwing B-47 multi-jet bombers.

USAF now has close to a million men in service; is training new pilots at a 7,800 annual rate, and is completing a chain of modern air bases stretching from the Arctic Circle to the African desert and literally girdling the globe.

▶**Equal to Mission**—During the next two years USAF will add 22 more combat wings to reach a level where its leaders feel it will be really capable of meeting its global commitments in the 'age of peril.''

With its expansion program operating at full throttle during 1953, USAF took a new look at its progress, problems and goals to revise them in terms of the new airpower doctrine.

The twin burdens of expansion and modernization accelerated by the Korean war produced management problems in USAF between 1950-53 that far surpassed anything in American industrial experience both in scope and complexity. It has been fashionable among some latecomers to the Pentagon scene to scoff at USAF management methods during this crisis when more than $50 billion was suddenly thrust upon an organization that was in the throes of an "economy" cutback. The combination of hindsight and the failure of the Third World War to materialize by 1954 give these gentlemen advantages not enjoyed by the men who had to struggle through the hectic period of 1950-53.

As the youngest of the military services USAF still suffers from a lack of sufficient capable leadership for its non-flying activities. However no service is making more strenuous efforts to develop management and technical career officers or emphasizes management concepts more throughout its activities than USAF.

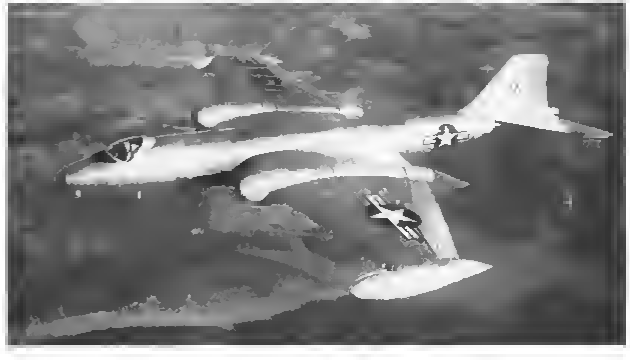
The full benefits from this program will not be evident for several years but it is obvious to Pentagon observers that USAF is moving in the right direction and at a lively pace. USAF has also exhibited a willingness to modify its command and organizational structures to meet the unique military problems arising from the swift developments in the atomic-aviation equation.

New Program

Most important result of the 1953-54 "new look" is the program for expanding USAF to reach a strength of 137 combat wings by 1957. This program differs only slightly in numbers from the 143 wing goal authorized just after the Korean war began. Six Troop Carrier wings are the actual difference. But there has been a significant recasting of USAF's combat composition in the new 137-wing program. Here is the difference in types of units authorized under each program:

	Old	New
Strategic Air Command	57	55
Air Defense Command	29	37
Tactical Air Command	40	34
Troop Carrier Command	17	11
Total	143	137

Basic reason for this change in USAF composition is the tremendous striking power offered by the new family of atomic weapons (AVIATION WEEK Aug. 17, p. 91) plus the growing threat of an intercontinental attack by the Russian air force equipped with atomic or thermo-nuclear weapons. The increase in Air Defense Command is aimed at meeting this threat particularly with the addition of five all-weather interceptor wings.



BOMBER FLEET making up USAF strength today includes Convair B-36 (shown left in FICON role with Republic F-84F), Boeing B-47 Stratojet (above as reconnaissance version RB-47E) and Martin B-57A for low level intruder missions.

▶**Potent Weapons**—The decrease in Tactical Air Command wings is possible because the new programmed strength of 34 wings equipped with the Republic F-84, Martin B-57A and Douglas B-66—all capable of carrying small size atomic bombs that pack the same destructive power as the weapon that devastated Nagasaki in World War II—has much greater striking power than the 40 wings previously programmed with conventional types of weapons.

The new program raises a question as to what good is achieved by reducing Strategic Air Command by two wings. Many observers believe that this trend should be reversed and an increase for SAC is in order. Most vulnerable point in the new program is the elimination of six Troop Carrier wings at the same time the new strategic policy calls for increased air mobility for the army to compensate for its manpower cuts.

▶**Airlift Needed**—To many Pentagon observers these two phases of the new strategic doctrine do not match. If the Army is to do its job successfully with fewer men it must have more airlift to enable the swift shifting of its strategic reserves to global trouble spots.

Other angles of the "new look" include:

- Moratorium on new base construction.
- Shift in procurement emphasis from mass production of current types to getting newer and improved types into production.
- Shift from a policy of obligating procurement money as fast as possible by letters of intent to hard bargaining on firm contracts.
- Major reductions in spares and spare parts procurement.
- Further stretchout of aircraft production.

Construction Problem

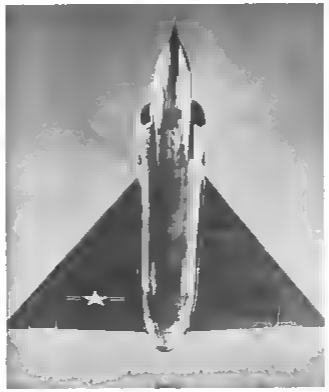
The moratorium on new base construction is expected to be lifted in fiscal 1955 with a billion dollar public works bill. However, even the USAF secretariat, who are the most enthusiastic about the "new look" economies, admit that considerable valuable time was lost in the USAF construction program by this moratorium. They anticipate regaining this lost time during 1954-55, but this goal appears too unrealistic.

USAF has a critical need for new construction not only for its global air base network for tactical and support units but also for its basic research, development and testing facilities. The postwar technical revolution in aviation made most of its wartime bases and research facilities obsolete and military budgets have not provided enough new construction to meet this critical need. The runways that sufficed for B-17s and Mustangs will not handle B-36s, B-47s or F-86s nor does the distribution of World War II bases meet anything but the modern training requirements for USAF.

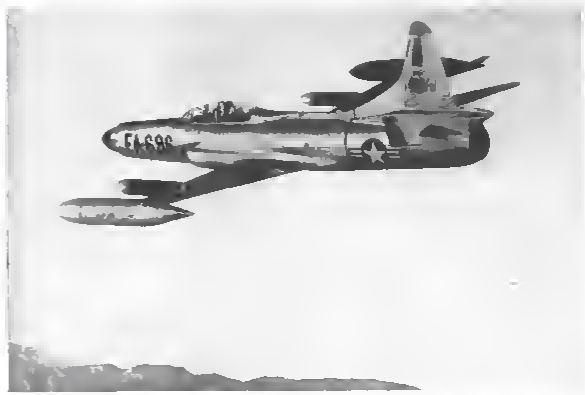
Most of the air bases built during World War II were scattered throughout the South and Southwest. The bases required now for air defense of North America and mounting intercontinental atomic air attack must be located in the northern extremities of the continent and its approaches. Base construction of the types required for modern jet aircraft and in the locations required by modern global strategy is a critical USAF need.

▶**Research Construction**—Similarly the windtunnels that served well for subsonic research are hopelessly obsolete

TOMORROW'S INTERCEPTOR is typified by the supersonic delta-wing Convair F-102 armed with air-to-air missiles.



Until the F-102 is in service



TODAY'S INTERCEPTORS will be the rocket-armed Lockheed F-94C

for the supersonic problems now confronting USAF. Modern test facilities, particularly for missiles, dwarf previous concepts of this function and require expensive construction.

The cost of the research and development testing facilities required for the era of supersonic flight and guided missiles is so high that no private contractors could afford to build or operate them without assistance from the government.

As the largest user of aeronautical research and hardware it is clearly USAF's responsibility to spearhead a program to provide these facilities which are vital if this country is not to falter in maintaining technical superiority in the air.

Procurement Shift

By next July USAF will have taken delivery on about 24,000 modern aircraft produced since the beginning of the Korean War in mid-1950. This sizeable increment of modern aircraft has alleviated the pressure of obsolescence on USAF, so heavy four years ago that units went into combat in Korea equipped with World War II vintage aircraft because there was nothing else available.

With the pressure for sheer quantity somewhat eased, USAF can afford to take a harder look at the qualitative aspects of its equipment. During 1953 there was a thorough screening of the USAF aircraft procurement program with a view toward eliminating future production of types that already were approaching obsolescence, types that would offer only marginal performance improvements over existing types; and types that appeared to be excessively costly to mass produce.

Funds recovered from cancelation of production contracts or removal of aircraft from future programming were used to spur production of new planes that offered considerable performance improvement and had already performed sufficiently in the air to indicate they were technically sound.

►**Emphasis on Quality**—For the future, USAF procurement emphasis definitely will be on quality of equipment rather than on sheer quantity or availability. There is also a definite USAF trend to reach for large qualitative improvements through the weapons systems development concept rather than nibbling at minor improvements through the model improvement philosophy.

One of the major clues to the size of future USAF procurement programs will be the variety of technically sound hardware offered by the aircraft industry.

The rate at which Air Force will require modernization of its aircraft inventory—another major factor in future procurement—will depend also on the rate of technical progress achieved by the aircraft industry. A good example of this may occur in the requirement for tactical aircraft where present plans for future production could be completely upset by the appearance of a technically sound vertical take-off fighter.

Contract Changes

In its haste to obligate the billions in procurement funds suddenly dumped in its lap after Korea, USAF used letters of intent freely. As a result an enormous backlog of contracting negotiations accumulated. Only last year did this mountain of unconverted letters of intent begin to diminish significantly. In some cases the actual production work specified in a letter of intent was completed and delivered to USAF before a firm contract was actually negotiated. This was poor procedure for both the contractor and USAF. Policy now is to delay actual obligation of new procurement funds until a firm contract is negotiated and use letters of intent only for emergencies such as modification programs or starting portions of an extremely long lead time program.

The USAF production program has been through several "stretchouts" since it was organized in the fall of 1950 when the impact of the Korean war had generated a frenzy equal to the production expansions of World War II. These earlier stretchouts were caused first by unrealistic production schedules that called for output far in excess of anything that industry could actually do even if given top priority on tools, materials and manpower. Their secondary cause was the unwillingness of the government to establish any effective priorities for the defense industries, including aircraft, on any of these three vital ingredients for accelerated production.

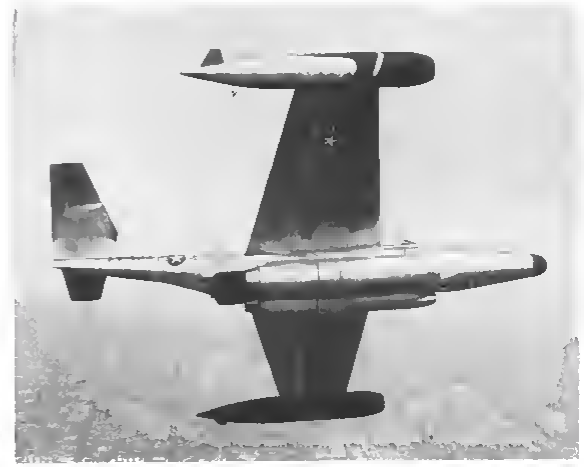
►**New Stretchout**—The stretchout quietly effected by USAF during 1953 was not based on the aircraft industry's inability to meet military production schedules. Its main purpose was to revise the production program realistically to alleviate the peak and valley that was looming for the industry in 1954-55. Industry could have easily reached the original production peak scheduled for 1954. But if this schedule had prevailed the industry would have gone from this peak onto a toboggan slide downward into 1955 and 1956 that would have meant closing some plants, loss of large quantities of production workers and a financial dislocation almost as bad as the 1946-48 period.

Now the production peak has been scraped off into a plateau extending through 1955 and the downgrade reduced to a more gentle slope reaching into 1956.

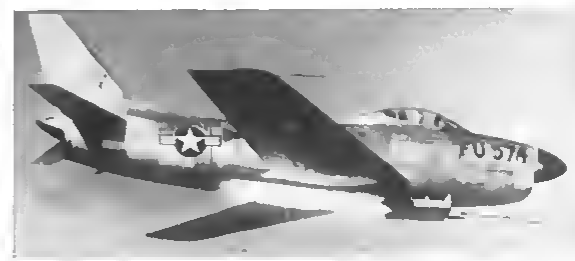
The 1953 stretchout was individually tailored to meet each company's specific needs and should do much to restore an element of stability to the aircraft production future.

When USAF began its post-Korean expansion program there was little operational experience available on which to base future requirements for spares and spare parts provision for jet aircraft. Since the jet engine was still in its early infancy operationally when the production expansion programs were organized, USAF planners allowed generous margins to meet future spares requirements. Operational experience of the past three years, particularly in Korean combat, combined with a rapid rate of technical progress, now make it possible to revise spares requirements on the basis of more factual data. During 1953 USAF was able to save close to a billion dollars by reducing its spares requirements and future savings will be even more substantial. There are still large areas ripe for further economy in the spares provision, depot operations and maintenance procedures and USAF is continuing to probe along these lines.

►**Fortunate Combination**—There have been many attempts to assign credit for the "new look" taken during 1953 to a specific source but Pentagon ob



NORTHROP F-89 Scorpions with podded, wingtip rocket armament and



NORTH AMERICAN F-86D with retractable rocket armament tray.

Major USAF Commands

Air Defense Command Ent AFB, Colorado	**Tactical Air Command** Langley AFB, Virginia
Air Materiel Command Wright Patterson AFB, Ohio	**Military Air Transport Service** Andrews AFB, Md
Air Proving Ground Command Eglin AFB, Florida	**Alaskan Air Command** Elmendorf AFB
Air University Maxwell AFB, Alabama	**Caribbean Air Command** Albrook AFB, C. Z.
Air Training Command Scott AFB, Illinois	**Far East Air Force** Tokyo
Air Research and Development Command Baltimore, Md.	**Northeast Air Command** Pepperrell AFB, N F
Headquarters Command Bolling AFB, Washington, D C	**USAF Europe** Wiesbaden, Germany
Continental Air Command Mitchel AFB, New York	**USAF Security Service** Brooks AFB, Texas
Strategic Air Command Offutt AFB, Nebraska	

USAF Planes on Hand

As of Jan in the year below	Type				Totals
	Combat	Transport	Trainer	Communications	
1942	4 477	354	7 340	226	12 397
1943	11 607	1 557	17 044	2 796	33 004
1944	27 448	6 466	26 051	4 267	64 232
1945	41 961	10 456	17 060	3 249	72 726
1946	26 077	7 500	7 611	3 558	44 782
1947	17 188	4 534	6 297	2 016	30 035
1948	16,116	2,534	6 714	1 440	26 804
1949	9 031	3,712	6,177	1,146	20,066
1950	6 004	2 839	5 611	658	17,222
1951	8 150	2 830	6 081	358	17,337
1952			—	—	20 000*
1953					20 500**
1954			—		22 300***

* Includes 16,000 in active inventory and 4 000 inactive
** Includes 16,500 active and 4,000 inactive
*** Includes 17 700 active and 4 600 inactive
SOURCE: USAF

USAF Aircraft Types on Order

Company	Plane	Name	Company	Plane	Name
Beech	T 34	Mentor	Martin	B-57	Night Intruder
Boeing	B-52 B-47 KC-97	Stratofortress Stratojet Stratofreighter	McDonnell	F-101	Voodoo
			North American	F 86F F 86D F 86H F-100 T-28	Sabre Sabre Sabre Super-Sabre
Convair	B-36J F-102 T 29				
DeHavilland	L 20	Beaver	Northrop	F 89D	Scorpion
Douglas	C 118 C-124 RB-66	Globemaster 2	Piasecki	H-21	Work Horse
			Republic	F 84F RF 84F	Thunderstreak Thunderstreak
Fairchild	C 119 C 123	Packet Avitruc	Sikorsky	H 19	
Lockheed	RC-121C T 33 C 130 F-94C	Constellation Starfire			

SOURCE USAF

servers who have followed the development of USAF since its creation in 1947 are inclined to assay it as a combination of the pressure of technical developments in both aircraft and atomic weapons, the emergence of USAF top leadership from the maze of the post-Korean crisis and the fresh stimulus of a new civilian secretariat With a good many of its management problems rapidly untangling during 1953, USAF entered 1954 in better shape to deal with its military missions

Strategic Air Command

With the end of actual fighting in Korea, the Strategic Air Command has regained its top priority on the USAF mission list

"Our most outstanding and as yet unchallenged superiority in air weapons is our ability to deliver them at long range " said General Nathan F Twining USAF Chief of Staff "It is necessary that we maintain and increase this advantage for several reasons

"First, the most critical targets in the Soviet Union are far beyond the Iron Curtain, some 1,300 mi or more from any accessible position on land or sea Only long-range bombers can traverse this distance if it ever became necessary to strike at Soviet aircraft factories, weapons centers, supply centers and sources of military power

▶ **Fighter Force**—"The huge Soviet air force despite its 1,000 long-range bombers is 95% short-range fighters and bombers We must be able to strike our heaviest blows from bases outside the range of these thousands of short-range aircraft

"They outnumber us heavily both in Europe and the Far East

"Only very-long-range aircraft can reach vital Russian targets from this hemisphere and from other areas more distant from the Iron Curtain than Europe and Japan While we hope to hold many forward bases, we must be able to strike effectively from our home bases and from intermediate bases that we can always use

"Long-range bombers can operate more effectively in bad weather and in darkness than can smaller planes with less equipment They can navigate more dependably and can spot targets more effectively under conditions more favorable for attack It has been proved again and again that these bombers can bomb just as accurately under combat conditions as can smaller planes operating at lower altitudes

▶ **Variety of Routes**—"Long-range bombers can operate over a variety of routes of approach and withdrawal and at a wider variety of altitudes, thus greatly complicating the task of enemy defensive systems They can carry more electronic equipment to detect enemy

FOUR SABRES streak off runway clawing for altitude Immortalized by Korean air war, the F-86 is mainstay of USAF fighter strength

countermeasures and to jam and confuse enemy radar.

"The big planes can carry heavier loads of any type weapon They can carry all types of bombs including the newest types Because of fewer limitations on size and shape, the bombs they carry are far more efficient than smaller bombs The smaller bombs are sometimes called 'tactical' bombs, but they are actually less suitable for use against many tactical targets Larger bombs cover more territory They are more efficient and effective in normal tactical situations that involve troops and equipment dispersed over wider areas

"Long-range bombers can be operated as a global force tied to no theater of operations and shifted from one continent to another as the need arises or as the situation demands They can be concentrated quickly to meet a threat or to exploit an opportunity They can go into action at a distance far more rapidly than any other type force and they can withdraw just as rapidly

"In the Korean war Lieut Gen Emmett O'Donnell was operating a wing of B-29s from a base on the far side of the world just five days after departing from the United States

"**Recently B-47 squadrons have moved from bases in the United States to Europe and Africa in less than a day B-36s can make round trips of that length without landing**

"During World War II B-29s operating out of Guam took 15 hr for their missions to Tokyo As an indication of how rapidly airpower has advanced since World War II, the B-52 can make two roundtrips between Guam and Tokyo in much less time than it took the B-29s to make just one mission

"Wars have been won or lost and tactics and strategy have been extensively modified because of a 20 to 30% increase in weapons capabilities Here we have a 100% increase in long-range air capability in just ten years time accompanied by a thousand-fold increase in the power of weapons delivered by air

"There is no longer any question that our total long-range airpower is a global force that must be centrally operated and controlled It can now be maneuvered over the Northern Hemisphere more rapidly than the armies of the past could maneuver over a single battlefield."

Mobility Formula

During the last nine months, SAC has combined the 600-mph speed of the multi-jet B-47 bomber with the virtually unlimited range provided by aerial refueling The process of converting SAC's medium bomber from B-29 and B-50 equipment to the B-47 is in full swing Aerial refueling by KC-97 tanker squadrons has become so routine that thousands of operational hookups are made between SAC bombers and tankers every month

The third element in this formula for unprecedented military mobility is the logistic support furnished by C-124 and C-97 transport squadrons—both from SAC's own transport organization and from Military Air Transport Service These giant transports with intercontinental range can furnish spare engines, aircraft parts, bombs, avionic equipment and ground maintenance crews at a 300-mph pace that far outstrips any other method of transport

▶ **4,800-Mi Jump**—This new method of SAC mobility has developed to a point where entire combat wings of B-47 bombers are making the 4,800-mi jump from permanent bases in Louisiana and Florida to the great complex of Moroccan staging bases in an average of 10 hours

Within 24 hours after arrival at the North African bases, these B-47 squadrons fly a 4,000-mi simulated combat mission deep into the heart of Europe The B-47 squadrons are accompanied by their supply train of tankers and transports, enabling them to carry on a sustained combat effort from the advance bases for 30 days or longer.

The SAC permanent bases in Florida, Louisiana, Texas and Arizona lie well beyond the range of the Tupolev 200, the longest-ranging bomber yet flown by the Russians However, the North African bases are within B-47 range of the Russian oil fields in the Caucasus, the factories of the Ukraine and many other vital targets

▶ **Fighter Role**—The combination of aerial refueling with small atomic bombs has also created a strategic role for fighter aircraft SAC now has a number of strategic fighter wings equipped with Republic F-84G jet fighters modified to carry small atomic bombs This same type fighter also has made nonstop crossings of the North and South Atlantic utilizing aerial refueling, and a complete F-84G fighter wing was moved from the Pacific Coast to Japan with servicing by flying tankers

SAC is getting F-84F sweptwing fighters as replacements for the straight wing G models, but its principle hope for future development of the strategic fighter role rests on the McDonnell F-101 Voodoo The F-101 is closer to an old-style medium bomber with a gross weight of about 30,000 lb and an extraordinarily long range for a jet fighter It also will have atomic capabilities

▶ **Interim System**—Development of the FICON system for carrying a parasite F-84F under the B-36 has opened another strategic application for the atomic-bomb-carrying fighter Once the basic technical hurdles have been surmounted in making the FICON operation routine, SAC undoubtedly will develop it as an interim measure to bridge

DEFENSE FORMATION of Lockheed F-94Bs from 318th Fighter-Interceptor Squadron at Thule, Greenland, roars over polar icecap

the technical gap until successful air-to-ground missiles are operational.

The atom-bomb-carrying fighter can ride underneath the B-36 during most of an intercontinental trip and then cut loose just outside the range of the Russian target defense interceptors for a supersonic penetration of the target.

If the fighter can locate the B-36 mother ship, it can hook on in flight for the return trip. If not, the trade of an atomic bomb successfully delivered on target for a fighter aircraft and pilot is good military business.

▶**Radar Picket Line**—FICON also will probably be used for long-range reconnaissance penetrations of enemy territory and as an early warning device.

This latter application would see the B-36 mother ship well equipped with airborne search radar and functioning as a picket plane along the perimeter of enemy territory.

When unidentified aircraft are located on the B-36 radar, the parasite fighter can be cut loose for swift investigation. If the target is identified as an enemy, the parasite can cut loose with a lethal blast of rockets or an air-to-air missile such as the Falcon to make the kill.

▶**H-Bomb Carrier**—Although the B-47 rapidly is taking over as the standard SAC medium bomber, the venerable B-36 is still its only heavy bomber. The B-36 fleet is likely to remain in active service for a good many more years with duty as a radar picket plane, airborne aircraft carrier for FICON fighters and possibly as an aerial tanker for jet bombers.

For the immediate future, the B-36 fleet probably will be the only carrier capable of handling the hydrogen bombs. First thermo-nuclear test device exploded at Bikini was about the size of a GCA trailer and usable weapons are not expected to be much smaller for some time. Hence it appears the B-36 is the only SAC bomber that will have sufficient bomb bay cubage for hydrogen weapons in the immediate future.

It is expected that the B-52 Stratofortress will be engineered to carry hydrogen bombs, but it will not be in any appreciable SAC service before 1957.

▶**Target Penetration**—SAC's basic approach to its problem of target penetration appears to involve the extremes of altitude—as high as possible to get above the effective areas of radar detection and as low as possible to approach underneath the lowest angles of radar coverage.

Current SAC bombers, such as the B-47 and B-36 as well as future developments such as the B-52 and B-58 supersonic Hustler, are aimed at high-altitude penetration. But also under development are several versions of an extremely low level strategic bomber aimed at making penetrations below the scope of radar detection.

▶**Supersonic Bomber**—For at least another five years, SAC will be dependent on subsonic bombers with a possibility that final target penetrations can be made by either FICON fighters or air-to-ground guided missiles such as the Bell B-63 Rascal in the final phase of this period. After that, development is pointing toward the supersonic bomber, of which the Convair B-58 Hustler is the principal project now in the mill.

After the supersonic bomber, the strategic role probably will fall to the intercontinental ballistic missile. There is some responsible opinion in military circles that too much development effort is being devoted to long-range aircraft development and not enough to bringing the long-range ballistic missile into the realm of a practical weapon.

USAF is sponsoring development of the Convair Atlas as a long-range ballistic missile and the North American Navaho as a cruising type of long-range missile.

Active Plane Inventory

	FY 1954	FY 1955
USAF	21,000*	22,900*
Navy	13,130**	12,900**
Total	34,130	35,800

*Includes 16,000 assigned to units
**Includes 9,941 assigned to units

Air Defense

Building an effective air defense system is a relatively new task for USAF. Except for the early phase of its participation in World War II, USAF was engaged primarily in offensive action—putting the burden of air defense on the enemy.

Neither the Germans nor the Japanese ever developed a strategic air offensive power. Now there is ample evidence to show that the Russians are making a determined effort to build a long-range strategic bombing force capable of delivering their atomic and hydrogen weapons over intercontinental ranges.

USAF now is faced with the problem of constructing an air defense system that will blunt and parry any possible thrusts of the Russian strategic air force against North American targets.

▶**Technical Burden**—The present trend in aircraft favors the offense and places an extraordinary technical burden on the defense. Since World War II, the cubage of air space available to the offense has doubled with the rise in bomber altitudes from 25,000 to 50,000 ft.

Bomber speed has increased from not much more than 200 mph. to 650-700 mph. and forced defensive fighters into the maneuverability restrictions of the transonic speed range.

▶**Increased Defense**—Not much more than a year ago Gen. Hoyt Vandenberg, then USAF Chief of Staff, estimated the continental air defense system would not be able to destroy more than 30% of an attacking bomber force before they reached their targets—even after the defensive system had been bolstered to its maximum capability and effectiveness.

Much more USAF effort now is going into air defense problems than when the general spoke, but there still is no cause for optimism in this endeavor. SAC bombers successfully practice bombing key American cities almost every night in the week, despite the best efforts of the air defense system to locate and intercept them. Even the venerable B-36 is an elusive target for the interceptors now available to USAF and Navy fighter squadrons.

Principal problems in building an effective continental air defense system are:

• **Warning.** Early-warning radar network still is sketchy and can be easily penetrated. Ground radar stations in the Arctic are extremely vulnerable to enemy air attack. Radar picket aircraft are not yet ready for routine operations along the Arctic and ocean approaches to North America.

U.S. and Canada still have not ironed out national differences over the type and location of early warning radar facilities. Major USAF effort is being devoted to solving technical problems of providing a semi-automatic type of ground environment for an air defense system that will gather, correlate and transmit data on an attacking force directly to airborne interceptors with only monitors on the ground to check the systems operations.

• **Interception.** Most USAF interceptors now in service do not have either the range or speed to intercept attacking bombers at sufficient distance from the target to make effective attacks before bombs are dropped. Range also is a basic weakness of the anti-aircraft missiles nearing operational use. This range limitation of the Army's Nike anti-aircraft missile has raised the question of whether the installation of Nike battalions supposedly to defend U.S. cities against bomber attacks is little more than extremely expensive Army propaganda.

The F-86D and F-94C have extremely limited range and operational time at the altitudes where they must attack enemy bombers. The F-89D has longer range, but there is a growing feeling in some USAF circles that what really is needed is an aircraft type that could function in the air much as a Navy destroyer does at sea. This type aircraft would be equipped with long-range airborne radar to locate enemy bombers, sufficient range to meet them a long way from their target and enough armament to conduct a running battle with them in the manner that submarine wolf packs harassed convoys at sea.

▶**Weak Fighters**—USAF still is building large numbers of day fighters in proportion to its production of all-weather interceptors. This trend continues despite development of all-weather interceptors with performance equal to or better than their day fighter contemporaries. Navy virtually has abandoned its day fighter category for future fighters and is equipping all its new, high-speed fighters with all-weather capabilities.

Another weakness in U.S. defensive has been their traditional design for offensive rather than defensive capabilities. In contrast, the design of the Russian MiG-15 emphasized its defensive role as a high-altitude interceptor featuring fast rate of climb, heavy armament and high altitude performance at the expense of its characteristics as an offensive fighter bomber.

▶**Defense vs. Politics**—Air defense of the North American continent also has become entwined with domestic politics and considerable pressure is being exerted on USAF, particularly from the more vulnerable population centers of the Northeast and Northwest, to devote a larger share of its effort to defensive efforts.

USAF policy has not veered from primary emphasis on its long-range retaliatory bombers as the best insurance against enemy air attacks, but it shows signs of bending slightly in the face of the political pressure for an umbrella of air defense.

Military men are aware, as the politicians are not, that an air defense system never can be built that will provide an invulnerable protective umbrella over American cities. Any determined enemy air attack with atomic weapons will cause tremendous destruction despite the best defensive efforts. All an air defense system can hope to do is to boost the cost of air attacks so high that an enemy will hesitate to pay it or, if he does, extract such a heavy attrition on his attacking forces, that he will lack the resources to sustain the attacks.

▶**Tactical Future**—The future of tacti-

AVIONIC EYES of airborne radar in F-86D team with ground set in U.S. defense

cal aviation is keyed to three technical developments:

- **Small atomic bombs**
- **Increasing all-weather capability**
- **Vertical-takeoff aircraft**

Development of small atomic bombs has given the fighter-bomber and light bomber a striking power undreamed of only a few years ago. They become an extremely potent weapon against ground forces that are forced to mass for offensive action. The Korean war proved that tactical airpower desperately needs a vastly improved capability for darkness and bad weather to clamp a firm stranglehold on enemy ground forces.

Vertical takeoff fighters now under development will free tactical airpower from the immobility of the 10,000-ft hard surfaced runways required by most fully loaded jet fighter-bombers.

Airlift Problems

Military airlift is a critical problem for both USAF and the Army. Combat operations of USAF require the speed of an aerial logistics system to take full advantage of the unique characteristics of air war. The 650 mph speed of SAC jet bombers cannot wait on the 90-day snail's pace of the conventional supply pipeline of surface transport.

The Army requires adequate airlift to fulfill its role as a fire department to extinguish minor aggressions wherever they occur. It cannot respond to international fire alarms on a global scale if it is keyed to surface transport. Nor can it meet these far-flung requirements with fewer men unless it gets the mobility afforded by air transport.

Military air transport resources now are scattered among:

- **Military Air Transport Service.**
- **Troop Carrier Command.**
- **Strategic Air Command.**

Most military planners agree the airlift requirements cannot be met by continuing the present dispersal of air transport equipment. How to reorganize these resources to meet the twin needs of Army mobility and USAF aerial logistics system is one of the really knotty problems being debated in the Pentagon. The air staff of USAF has been wrangling with this problem for more than a year and there are indications that if a solution is not proposed soon by USAF, the Army will take steps to develop its own long-range airlift.

▶ **Transport Family**—USAF and the Army are agreed on a technical development program calling for production of a family of transports ranging from the Chase Fairchild C-123 Avitruc as the smallest members through the Lockheed C-130 in the medium class and the Douglas C-124 and C-133 types as the heavy transports.

This family is aimed at meeting the requirements for military airlift from the shorthaul assault transport assignment to long-range intercontinental operations.

All of these transports will have cargo compartments designed to standard military equipment dimensions and standard loading heights.

USAF already has conducted successful experiments in aerial logistics for movement of jet engines under the pressure of the Korean war, but it is moving extremely slow in making wider applications of this experience.

▶ **Combat Cargo**—One possibility for the reorganization of military airlift is the creation of a combat cargo command along the lines successfully pioneered during the Korean war by Lt. Gen. William Tunner and Brig. Gen. John P. Henebry.

Basic concept of this type airlift is concentration of all air transport resources under a single command and trained to perform any type of airlift mission, including delivery of assault troops to combat zones, air drop of supplies to combat units, air evacuation of sick and wounded and long-range airlift of supplies and reinforcements. The airlift available from this type organization is assigned on a priority basis to the most critical need at the time as determined by the military high command.

If the Tunner-type combat cargo command were used as the new airlift pattern, it is likely that MATS would be stripped of its cargo planes and would function primarily as a military courier service and operator of air bases and facilities that did not fit into requirements of other command but were necessary in the national interest.

There is another possibility that, in the organization of an aerial logistics system, the commercial airlines will be given primary responsibility for operating the military cargo services required within the North American continent leaving the purely military airlift available for long-range foreign operations.

Weapons Systems

The future of USAF and the country depend on the continued maintenance of technical superiority in the air. With tremendous increase in the destructive power of airborne weapons, the emphasis has shifted from sheer quantity to superior quality.

During the past 18 months, USAF has shown an increasing sensitivity to the critical need of improving its qualitative position. It is placing more emphasis on the development of complete weapons systems instead of individual items of hardware jiggered into an airframe envelope and is taking a more active role in extending the scientific frontiers of field pertinent to the growing technical requirements of the atomic airpower capability.

Spearhead of this development is a new realignment of the authority and responsibilities of the Air Research and Development Command and the Air Materiel Command aimed at a more realistic role for the quality factor in USAF aircraft and equipment development. The development of the single prime contractor policy was another attempt to supplement the limited management and technical skills available within USAF with this type of talent available in industrial firms.

USAF also is in the midst of a program aimed at constructing the type of development and testing facilities required by its industrial contractors for their new products.

MATS OPERATIONS

	Passenger-Miles	Patient-Miles	Total Ton-Miles
June 1-Dec. 31, 1948	280,386,061	24,253,934	76,174,067
1949	438,893,176	39,149,352	128,529,796
1950	532,903,605	170,416,149	173,559,413
1951	666,891,763	221,747,514	263,727,904
1952	950,853,198	149,015,307	285,870,882
1953*	1,064,362,673	131,531,287	318,677,141

*December 1953 figures are estimated

MATS TONNAGE

	Passengers	Patients	Cargo & Mail Tons	Total Tons
June 1, 1948-Dec. 31, 1951	980,972	157,028	199,000	326,000
1952	495,491*	62,352	86,643*	147,720
1953**	471,012	58,304	82,115	136,029

*After August 1952, ZI passengers, cargo and mail, total tons ARE NOT included. ZI patients are included.

**December 1953 figures are estimated

GRUMMAN COUGAR touching down on carrier deck symbolizes postwar technical advances in carrier based aircraft designs.

■ NAVY

Naval Aviation Makes Rapid Progress

New developments in anti-submarine warfare, VTO interceptors and helicopters spur jet-propelled resurgence of carrier-based airpower.

Naval aviation, after lagging behind in the development and production of new aircraft, during 1953 made rapid gains and today 70% of the planes in the Navy's 16 carrier air groups are jet-powered.

Developments during the year include

• **Vertical takeoff interceptors.** Three years ago the Navy held a design competition for VTO interceptors and contracts were awarded to Convair and Lockheed. The Convair model, XFY-1, is a delta-wing aircraft. Lockheed's XFV-1 is a straight wing model. The XFV-1 has already flown horizontally and Navy plans vertical test flights soon. Both are powered by the Allison T40 turboprop rated at 5,500 eshp. with contra-rotating propellers. The planes do not require any other power for takeoff. If the plane lives up to expectations, Navy feels VTOs could be the greatest advancement in fighter aircraft since the jet engine. A major role for VTOs in convoy duty, close-support work and air defense is forecast.

• **Douglas F4D Skyray,** which will be coming into operational service with fleet units by the end of this year, set a world speed record of 752.9 mph over the 1 863-mi. course at Thermal, Calif. The Skyray is Navy's blue chip fighter, and production models will be equipped with Pratt & Whitney Aircraft's J57 engine. Westinghouse engines were used in the prototype.

• **Powerplant difficulties eased.** Much of Navy's troubles in new planes came from technical problems with jet engines. The Westinghouse J40 engine will be replaced by the Allison J71, and while there is no engine planned to replace the Westinghouse J46, Navy is banking heavily on the P&WA J57 to drive its planes. P&WA's J75 and Curtiss Wright's J67, still under design, are other engines Navy is watching closely. As far as powerplants are concerned, Navy feels it is "out of the woods."

NAVAL AIRCRAFT ON HAND 1953	
Operating USN	9,198
Operating USNR	1,686
Support	2,381
Reserve Stock	721
Miscellaneous	950
Total	14,936

• **Resurgence of water-based aircraft.** After a seven year Navy hydrodynamic development program, the F2Y-1 Sea Dart made its first flight last April off San Diego Bay. Other major development in water-based aircraft is the four-engine R3Y Tradewind. Its highspeed blended hull design has helped put it in a speed class with land based aircraft. Both are Convair aircraft.

• **First F3H-1N Demon production** model delivered to Navy. The new dual-purpose, all-weather fighter and fighter-bomber is being built in quantity by McDonnell, and has undergone extensive carrier tests. The first 60 Demons will be powered by the Westinghouse J40 with afterburner, but the remainder will have Allison J71 engines. Operational units will receive the F3H within a year. McDonnell is also building a Demon model capable of launching missiles.

DIVERSIFIED developments in Naval air include tailless Chance Vought F7U-3 to be phased out in favor of A2U.

LOCKHEED P2V anti-submarine plane combines piston power with turbojets.

MARTIN P5M long-range patrol boat has high length beam ratio hull.

• **Grumman S2F** is now in production. It is a "single-package" aircraft combining the hunt and attack functions of the AF-2S and the AF-2W for anti-submarine warfare.

• **Douglas A3D,** a twin-jet attack bomber, made its first production flight last fall. The plane's power comes from two J57-P1 engines, and provides the Navy with a highspeed long range carrier-based aircraft. Squadrons will be equipped with the new bomber in less than a year. Although the Navy is quick to point out that nearly all naval aircraft have atomic bomb delivery capability, the A3D will have a major role in this vital assignment. It is now going through board of inspection and survey tests.

• **Operational deliveries of the Chance Vought F7U-3** are being made. Although engine production difficulties snarled the Cutlass program, Navy is confident that the tail-less fighter will prove a versatile aircraft. A missile launching model is also being produced. Production of the F7U will be phased out sometime this year, and the A2U will be put on the line.

• **Helicopter** emerged from a purely

'paper consideration' to the rank of a prime anti-submarine warfare factor, with current tests checking its mine-sweeping capabilities.

▶ **Configuration Problem**—Navy's "orphan in the storm," as one officer called it, is the F2Y Sea Dart. Snags in its development during the past year led some high Navy brass to be pessimistic about its outcome. However, progress, though slow, is encouraging for such a radical new design.

Designed in 1951 the fast, water-based fighter has not met what some are now calling an unwise timetable set for it. Configuration of the hydro-ski landing gear is the big problem and changes are expected this year after rough water tests are completed.

Powerplant is also a problem. Powered by two Westinghouse J46 turbo jets, the Sea Dart does not yet have sufficient thrust. Engineers on the project expect to see the aircraft go into production with a single engine, probably either the Pratt & Whitney J57 or Allison J71 turbojet. All are agreed that many problems remain to be solved before the F2Y is production bound.

Marines are interested in the delta, supersonic fighter as tactical air cover for amphibious or airborne assault. Big advantage of the ship to the Navy would be its flexibility and its minimum requirements for satisfactory base.

Glenn L. Martin too is working on another design of this type for Navy.

GRUMMAN F9F-6 with unpainted wing panels banks above Douglas F3D Skyknight.

Strategy

Navy's role in today's global strategy is explained by Adm. Robert B. Carney, Chief of Naval Operations:

"Stated in its simplest terms, the Navy's traditional job has been, and still is, to gain and maintain control of the seas. More specifically, the U. S. Navy in conjunction with Allied naval forces must exercise positive control over those sea areas needed for our own uses and those other sea areas of critical importance to the enemy. The Navy will also have collateral tasks in support of the armies and air forces, and these additional responsibilities may be expected to increase with the Navy's ever-increasing range of tactical influence."

New Carriers

The attack carrier force, composed of 16 air groups operating from 14 carriers is the backbone of Navy's striking power. Three classes of attack carriers are in operation today. The Midway, the Oriskany and the Essex classes. The Essex will be replaced within a year by the Hancock class, which is similar to the Essex but has the steam catapult and higher capacity arresting gear. There are today three Midway carriers, nine Oriskany and five Essex-class ships operational.

▶ **Four Forrestal Class**—The first of the Forrestal-class carriers is due to be completed in July 1955. Second Forrestal-class carrier, the Saratoga, is scheduled for completion in February 1956. Contract was let last month for construction of a third of this class, and Navy's fiscal 1955 appropriation request contains money for a fourth. Navy had planned to put atomic engines in the fourth carrier, but the idea has been abandoned and conventional engines will be used.

The four carriers will have canted decks which permit a two-runway system.

Navy says that in flight operations during the past months aboard the canted deck carrier Antietam more than 5,000 landings were made during daylight, darkness and low visibility without a single barrier accident. The steam catapult, superior arresting gear and canted decks have had a strong effect on Naval aviation, permitting operation of supersonic fighters and attack planes from carriers.

Navy air groups range in size from about 70 to 110 planes, depending on the carrier they are working from and the group mission.

▶ **Peak in 1955**—For aircraft procurement Navy has adjusted its sights for the long pull. The peak of aircraft deliveries, once set at 300 per month by mid 1954, has been scaled down to a peak delivery rate of 250 aircraft monthly to be reached early in 1955. The delivery rate then will decline slowly.

In pilot training, Navy is meeting its goal of 3,200 pilots for fiscal 1954, and 3,100 are scheduled to be trained during fiscal 1955. The loss of 100 is due to a drop in the number of foreign pilots being trained under MDAP.

The Marine Corps is allotted about 1,000 pilots from the training program and Navy gets about 1,900. Remainder are Coast Guard and MDAP pilots. Marine pilots man three wings assigned to the three Marine divisions.

FLIGHT REFUELING contact is made between probe of Grumman F9F and drogue trailing from North American AJ aerial tanker.

ASW Progress

Big accomplishment during the past year in the accented anti-submarine warfare phase of naval air operations was the gradual development of the team concept between air, ship and submarine divisions. Members of the three groups are interdependent on each other in clearing the sea lanes, are now working more closely together than ever before. ASW has come of age.

Test of Navy's work in this field comes this spring in a gigantic Atlantic maneuver which officials say will prove that ASW is now finally getting its feet on the ground.

Start of deliveries at the end of 1953 of two different model helicopters specially designed for ASW work helped bring this about. These are the Bell HSL and Sikorsky S-58 copters. To date Navy hasn't found any other copters which meet its needs for ASW.

▶ **Assigned to Units**—The Bell copter is now in production and undergoing further tests at Patuxent Naval Air Station, Md. The first production models are being assigned to ASW units. After some delay the Sikorsky copter will soon join the fleet.

Both are equipped with avionic detection gear. Tests on the first few delivered to Navy prove the helicopter has a permanent role in this phase of naval air operations. Earlier copters were used experimentally, but their lack of power was their weakness.

Heavy strain exerted on engines in the dipping and hovering requirements of ASW copters requires more rugged powerplants than were available in earlier models.

▶ **Screening Operation**—Helicopters are to be used primarily in groups as convoy screens flying ahead of Navy convoys and as regular search and attack units. Navy looks forward to equipping later models with weapons which can destroy as well as detect enemy subs.

Experiments are being carried out at Panama City, Fla., to test the helicopter's capability as a minesweeper. Experiments are being run on dragging hook cables through the water to snag mine lines.

Complying with Navy's traditional habit of hanging everything possible on new aircraft to further experiments, sonobuoys are also being placed in the new carrier-berthed copters. This year will see the introduction of a British model sonobuoy, the T1946A, which will be used until Navy comes up with bigger improved model. Present U. S. made sonobuoys are non-directional and thus impractical in the present state of anti-sub warfare.

▶ **Sonobuoy's Role**—Accent has been placed on the use of sonobuoys in the past few years. Schnorkel submarines offer minute radar signals for standard airborne research radar. With sonobuoys dropped into the water from the air, detection is simplified.

During the past year, the carrier-based Grumman S2F passed all its tests with flying colors and is now being introduced into the fleet as quickly as

ANTI-SUBMARINE duties will be taken over by Grumman S2F, twin-engine plane replacing hunter-killer team of Grumman AF-2s.

TURBOPROP TRADEWIND is Convair R3Y, 80-ton, 350 mph flying boat now under evaluation for logistic support of fleet units.

NAVY TRANSPORT for highspeed movements by air is Lockheed Super Constellation powered by Wright Turbo Compound R3350s.

Grumman can produce the twin-engined aircraft. The S2F made its first appearance in 1952. Last year's tests, including extensive flight trials aboard the USS Coral Sea in the summer, caused Navy to bank heavily on the ship. It is powered by two Wright R1820 Cyclone engines.

▶**Neptunes**—Last year also saw the introduction of jet pods to the Lockheed P2V Neptune series of patrol bombers. This land-based aircraft has been fitted with two Westinghouse J34 turbojets, one under each wing, to supplement its two Wright Turbo Compound piston engines. This is probably Navy's final aircraft use of Westinghouse turbojets.

In the jet-modified version—the P2V-7—jets supplement piston power to speed the bomber to its target and home again. Over the enemy target, its compound engines—minus the turbojet thrust—hold the bomber to a slower speed. Navy sees the P2V-7 series useful for some time to come.

Another plane high in Navy's regard for ASW is the Martin P5M Marlin powered by two Wright R3350 Compound engines. A seaplane, the P5M went into squadron service in 1952 and last year was performing heavy duty. Navy's respect for the P5M points up the current resurgence of Navy thinking toward the seaplane. A new Martin seaplane, the P6M, is jet powered and designed as a minelayer.

▶**Duty for Blimps**—Blimps, the lighter-than-air craft which Navy has long used against subs, began last year to take over a vital role in the ASW program. Principal model now is the Goodyear ZP3K, which is heavily loaded with sonar and other detecting devices as well as torpedoes.

Earlier thinking on the blimp restricted its use to coastal areas. But with the increase in the size of the new models, they are acquiring greater range. The ZP3Ks are being given added responsibility for convoy protection, although few have been built thus far. An even bigger, longer-range blimp is the Nan, which is now being tested at Key West, Fla., indicating that Navy considers the blimp of ever increasing importance.

▶**Use 11 Carriers**—ASW carrier operations are carried on currently from the decks of five Essex-class carriers and six of the smaller "jeep"-type carriers, so named because of their size. The five Essex-class have not been converted to the angled-deck principle.

The canted-deck concept is not necessary for ASW operations. Present thinking is that the Essex-class carrier is as large as will be necessary.

▶**Seaplane Tests**—In the increased emphasis on sea-based aircraft, Navy rolled out its Convair R3Y Tradewind cargo passenger seaplane late in the year and the big ship made its initial flight tests last month.

Powered by four Allison T40 turboprops, the 80-ton long-range transport has a speed of more than 350 mph. Observers believe it will have important commercial applications.

Navy experts expect great things from the R3Y as logistic support for the fleet. Evaluation flights will be continued throughout the next several months in San Diego Bay, after which the ship will be flown to Patuxent, Md., for further tests.

Present success of the sea based aircraft will bring development this year in special equipment and housing for servicing all water-based aircraft, assuring that type of aircraft a place in Navy's sun for years to come.

U. S. NAVY AIRCRAFT

Company	Plane	Name
Cessna	OE	Bird Dog
Chance Vought	F7U-3	Cutlass
	F7U-3M	Cutlass
	F7U-3P	Cutlass
	A2U	Cutlass
Convair	F2Y	Sea Dart
	R3Y	Tradewind
Douglas	F4D-1	Skyray
	F4D-2	Skyray
	AD-5	Skyraider
	AD-5N	Skyraider
	AD-5S,W	Skyraider
	AD	Skyraider
	A2D-1	Skyshark
	A4D-1	
	A3D-1	Skywarrior
Grumman	F9F-6	Cougar
	F9F-6P	Cougar
	F9F-7	Cougar
	F9F-8	
	F9F-9P	
	S2F-1	
	UF-1	Albatross
Lockheed	R7V-1	
	R7V-2	
	WV-3	
	P2V-5	Neptune
	P2V-7	Neptune
	TV-2	
Martin	P5M-1	Marlin
	P5M-2	Marlin
McDonnell	F3H-1N	Demon
	F3H-2N	Demon
	F3H-2M	Demon
	F3H-2P	Demon
North American	FJ-2	Fury
	FJ-3	Fury
	FJ-4	Fury
	AJ-2	Savage
	T-28B	
HELICOPTERS		
Bell	HSL	
Hiller	HTE	
Kaman	HOK-1	
Piasecki	HUP-2	Rescuer
	HUP-2S	
Sikorsky	HUS-1	
	HO4S-3	
	HR2S-3	
BLIMPS		
Goodyear	ZP2N-1W	
	ZP4K	
	ZP5K	

Source: U. S. Navy

AMERICAN LATEX' NEW STAFOAM

"Plastic Surgery" for the most sensitive nose in the world (see next page)

Stafoam Plastic Allows Radar Energy Transmission Up to 99% in F-94C Radome

With deadly accuracy, Lockheed's sleek Starfire can automatically aim and fire up to 48 rockets any one of which could knock out the biggest bomber flying. The bullet shaped radome, or nose, houses the sensitive radar scanner that tracks down the prey. Its effectiveness in allowing the radar beam to pass through unimpeded is due to the use of Stafoam in the construction of the radome itself

Inexpensive Stafoam Provides Sufficient Strength and Rigidity to Radome Yet Offers Negligible Resistance to Radar Beam—

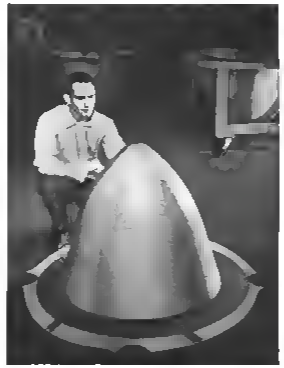
The terrific rocket fire power of Lockheed's super F-94C fighter (48 rockets including wing pods) would be largely wasted without the sensitive, critically accurate radar firing mechanism housed in the radome.

The radome itself must be manufactured with infinite precision to allow the radar scanner installed inside of it to operate effectively. Most important, the materials used for the radome must, of necessity, allow the electrical magnetic beam to pass through without being deflected, distorted or impeded. The radome can be compared to an optical lens—where the physical characteristics of the material influence the efficiency in the transmission of rays.

Stafoam is poured into a mold lined with thin fiberglas polyester shells. After the Stafoam solidifies and is cured, it is securely bonded to the fiberglas laminates forming a light weight rugged sandwich about 3/10 inch thick.

Stafoam Now Used In Structural, Insulation and Safety Fields

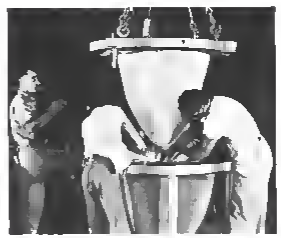
In addition to its structural use for aircraft construction the many varied types of Stafoam make it applicable to almost every other industry. Its limitless range of hard to soft forms and its slow flex recovery, make it especially suited to the impact and collision field. Also, because of its low thermal conductivity rate it is superior for insulation.

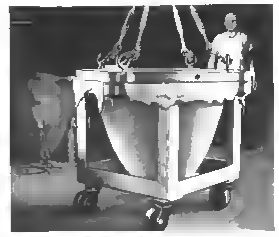


The bullet shaped radome, just removed from the mold, holds the exact contour during curing. The close tolerances required for its effectiveness make little allowance for shrinkage or expansion

Stafoam is Easy to Mix and Pour

One of the most remarkable characteristics of Stafoam is its simplicity of application. By merely pouring the contents of one container of a given formulation into another container and gently mixing for several seconds, the correct balance is obtained for the exact consistency and density desired. And, it never varies. By following the very simple directions, any non-skilled employee may apply Stafoam to your product. With Stafoam there is no measuring of ingredients necessary. The exact proportion of the two ingredients can be predetermined by American Latex for you—and packaged ready to mix and pour. Some formulations allow for self curing, thus eliminating the necessity for costly ovens.





In spite of the critical tolerances allowed in the finished radome, its construction can easily be handled by non-skilled help. Here two employees are pouring liquid Stafoam into mold. Within seconds after mold die is lowered into mold, foaming takes place.

Sudsy Stafoam can be seen foaming from the sides of the mold. Within a very few minutes it sets in set. Complete curing takes about a twenty hour cycle. The Stafoam bonds the two thin layers of fiberglas laminates together.

Lockheed Tests Prove Stafoam Has Exceptional Strength to Weight Ratio

Because of Stafoam's superior strength to weight ratio, Lockheed Aircraft Corporation has now found many well suited uses for it. A few of its current applications at Lockheed are: structural filler for rocket exit doors, radomes, aileron filler, antenna housing, shock boards, underwing fillets, reflector beam assembly and others. Unlike many foam products the cell structure of Stafoam is of a non-connecting type, making it stronger, buoyant and moisture-resistant.

NOTICE!

Although the information contained in this advertisement covers only one application, Stafoam is supplied in hundreds of densities, textures, hard and soft with applications for almost every industry.

Some formulations allow self curing, others provide for heat resistance in excess of 300°F.

For more general information on this truly versatile foam plastic, write for our Stafoam brochure of the following address:

American Latex Products Corp
PLASTICS DIVISION
3341 West El Segundo Boulevard
Hawthorne, California

Stafoam is Self Bonding to Most Materials

The bonding qualities of Stafoam during curing eliminate the tendency to pull away from the surfaces surrounding it. This important feature not only makes Stafoam a superior insulating substance, but more important, it becomes an integral part of a structural unit. Loads are distributed equally, thus adding tremendous strength to any unit containing Stafoam.

The bonding quality of Stafoam is another reason why it is perfectly adapted to Lockheed's F-94C radome. It combines the two fiberglas laminates into a single lightweight unit.

After a two hour curing period in the mold, the radome can be removed for post-curing.

STAFOAM, a registered trademark of American Latex Products Corp., is manufactured under *LOCKFOAM patents owned by Lockheed Aircraft Corp., Burbank, Calif.
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DOUGLAS GLOBEMASTER provides air mobility for heavy Army equipment including tanks, heavy artillery, bulldozers and trucks.

Army Puts New Stress on Air Mobility

ARMY HELICOPTER squadrons bring swift supply to combat troops in rough terrain.

FIELD TELEPHONE wire can be laid at 120 mph from copters or liaison planes

By G. J. McAllister

A new concept welding airpower strategically and tactically to ground forces and their equipment is rapidly gaining favor in the Army's staff councils.

The concept embraces two distinct missions

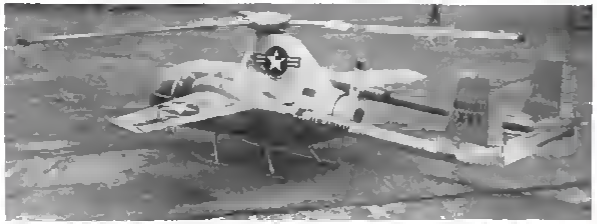
• **The strategic airlift.** This provides for air transport of troops and equipment over long distances, giving the Army a strategic mobility that goes beyond the tactical air drop. The airlift task would be carried out by the Air Force.

• **The tactical airlift.** This mission, confined to the ground fighting zone, is handled by Army aircraft under the direction of the Army field commander and calls for short-range helicopter lift of men and supplies. In addition, observation, reconnaissance, casualty evacuation and such operations as wire laying are part of the task.

The strategic airlift concept was pushed effectively by Earl D. Johnson, an imaginative and forceful airpower advocate, when he was named to the Army secretariat in 1950. Johnson is now president of the Air Transport Assn.

▶ **Three for One"**—"The key to our plans must be mobility—fast, dependable, ever present capacity for mobility—land, sea and air mobility—mobility which is capable of confusing and outstripping enemy intelligence," Johnson believes.

"We need—and dreadfully need—the



CONVERTIPLANES like McDonnell XV-1 are Army's hope for frontline liaison work

capacity to deliver relatively powerful forces of men and materiel rapidly to any part of the world. The concept of envelopment—the tactical end run—in battle must be freed from the limitations of mud, mountains, morasses, yes, and even roads," Johnson says. "It must be a surprise action which is a vertical or horizontal movement over all types of terrain by means of which our ground forces can be augmented, withdrawn, or redisposed rapidly.

"In short, we must be able to hit our enemy three times for each blow we receive. This, you will readily see, in effect increases our relatively limited manpower resources at least threefold."

Johnson puts his finger squarely on the basic strategy. "People are always saying that we should take the initiative—that we should force any potential enemy to meet us on our terms, rather than for us to meet them on theirs. I agree with them, but, believe me, it is extremely difficult to achieve this initiative, particularly when we have dedicated ourselves to the maintenance of the peace and have knowingly denied ourselves the right to initiate war.

"This means we have denied ourselves the right of saying when, where, and, to some extent, how a war will be fought. I say to 'some extent how,' because I believe that if we mechanize our forces and provide them with the mobility which airpower alone can achieve, to that extent we control the how."

► **Army Views**—Army aviation backers see it this way:

▪ **The tactical air drop mission** has defects which would be overcome by linking the strategic airlift—the long move—and the use of the Army's organic aviation—the short move.

• **The helicopter tactical airlift** can be carried out promptly in any weather with greater safety. An airborne unit in an overseas theater is always a target of enemy intelligence. Its commanders require a minimum of 45 days in which to plan and execute a drop, and airborne troops require special training and equipment. Army points out that their organic helicopters will lift quickly any required troops, whether paratroopers or not, to any spot point in the combat zone.

Positive indication that the Army is tailoring its forces to the strategic airlift concept is evident in its research and development program. A major part of the research effort is directed toward lighter, less bulky models of

CESSNA L-19 makes pickup of message from ground forces in field

present materiel that Army employs.

The Corps of Engineers has developed a "family" of air transportable equipment. Bulldozers, graders, carryalls and air compressors have been redesigned to the present capabilities of airlift. Experiments in the air drop of such equipment have been only partially successful. In the metals field, titanium with its strength, lightness and resistance to corrosion is under intensive study. Half the weight of steel and possessing the same strength, titanium models of such basic infantry equipment as mortar baseplates have been produced. Prospects for titanium fabrication of vehicles are excellent.

► **Concern Over Cut**—The Army is disturbed over the recent "new look" decision that cut the troop carrier wings to 11 from the 17 contained in the former USAF 143 wing force. Army has been pressing for an increase in the original 17 wing goal for troop carriers. With a cut in both manpower and airlift wings, the Army is deeply concerned over its ability to meet its global tasks since the present strategy is to make up the lack of numerical advantage through superior mobility.

Air Force today is procuring the C-119 and the C-123B from Fairchild, the C-118 and C-124 from Douglas and the C-130 from Lockheed. Progress of the 100,000 lb.-payload prototype (XC-132 turboprop) Douglas is building is being followed closely.

USAF at the secretariat level is also studying the effect of airlift on logistics.

► **Cuts Time, Cost**—Assistant Secretary of the Air Force Roger Lewis says:

"The Air Force is doing a great deal of work in the logistics field. An essential ingredient of airpower is, of course, mobility, and since United States airpower has become global in scope, we find that there is much to be done and we are attacking the problem with great energy. For example, under the usual military supply formula, the engine pipeline from manufacturer to depot across the seas and from depot to user is about 200 days. The current cost for jet engines makes 200 days' supply represent quite an investment and provides the opportunity for real reduction in the cost of military operations.

"Improved procedures, better equipment, and airlift instead of transport by surface promise not only enormous economies in materiel but greater mobility as well.

"For every four tons shipped to the field only about one ton constitutes actual supplies. The balance is in packaging and crating. Better crating or, better yet, no crating at all where air movement can be counted upon, offer means of great savings to the taxpayer for more airpower at a lower cost."

► **Evacuated 16,000 Wounded**—With new metals and new concepts for ultimate utilization of aircraft, Army today is busy studying the great lessons of Korean operations. Army pilots flew 500,000 hr. in Korea in undertaking 140,000 combat missions of reconnaissance and artillery spotting. Army aircraft lifted 16,000 casualties from the battlefield.

A narrative diary of the operations of the 6th Helicopter Co. in Korea using H-19s relates the capabilities of Army aviation:

"It became the duty of the unit to supply three regiments on the line with food, fuel and ammunition for a period of three days. Fourteen helicopters broke ground ... flying through rain squalls. The choppers made 150 roundtrips to and from the nine drop sites in the front lines.

"Totals showed that one helicopter company—not even full strength—had hauled an astounding 622,684 lb. of supplies. They had winged their ways through 1,486 relays between the division supply points and the frontline doughboys."

► **Today's Lineup**—Army aviation today is based on four types of aircraft:

- Two-place fixed-wing (L-19).
- Multi-passenger fixed wing (L-20).
- Utility helicopter (H-13, H-23, H-25).
- Cargo helicopter (H-9, H-21, H-37).

Assignment of these aircraft to divisions breaks down to 13 two-place fixed-wing planes, three multi-passenger fixed wing craft and 10 utility helicopters for each division. These aircraft are used to provide reconnaissance for the division commander and staff, emergency aerial resupply and transportation to other headquarters.

► **Third Dimension**—In addition, non-divisional units such as engineer combat groups, corps artillery headquarters batteries and transportation helicopter companies are provided with organic aircraft. Largest number goes to the transportation helicopter companies, which have 21 cargo helicopters each. Army has an inventory of about 3,000 aircraft.

Use of Army aircraft has added a vital third dimension to the Army mission. Helicopters have proven extremely valuable in engineer survey operations where they are used to select triangulation points and transport parties to inaccessible locations. One helicopter operating with a survey party in Alaska last summer permitted to party to accomplish work in one day that otherwise would have required 20 days to perform, an Army report shows.

Use of aircraft with armored units is a major means of controlling tank operations, and provides aerial flank security patrols that release ground units from this assignment.

► **Wire Laying**—The Signal Corps has

BELL LIAISON copters scout the enemy and direct movements of Army tanks

developed the technique of laying wire by liaison planes and helicopters. The extensive telephone net required by field forces involves a rugged support operation for the men who must put down wire across mountains and other forbidding dangerous terrain. Helicopters today can lay wire across any terrain at speeds up to 100 mph.

Experiments are being conducted today to put the poles in by helicopter with metal prongs spearing the poles into the earth after being dropped.

In Korea, a Signal Corps battalion commander estimated that one aircraft permitted him to take 20 jeeps off the road for messenger service.

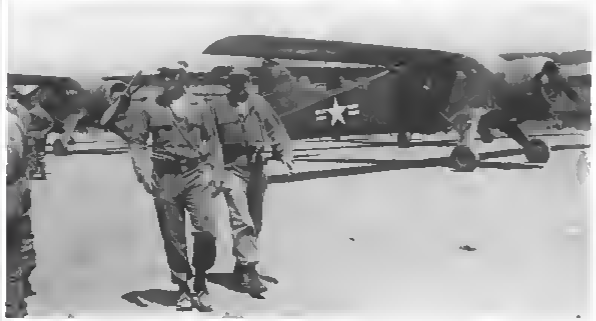
Army is putting its blue chips on the helicopter, particularly the H-37, which can carry 28 fully-equipped men into battle. They are sharing Sikorsky's output with the Marine Corps.

Convertiplane research has been spurred by Army funds financing the XV-1, XV-2 and XV-3 projects.

▶ **Observation Solution**—"The convertiplane today is strictly a research aircraft," says Lt. Col. Robert R. Williams, chief of the Army Aviation Section, G-3 (Operations). "But already we see it as an excellent solution to our observation aircraft problem—a plane that can take off in zero space and have the forward speed advantage of fixed-wing aircraft. We do not see the convertiplane today replacing the cargo helicopter."

The Army has its own pilot corps to fly its aircraft. To meet this demand—currently about 1,000 a year—Army trains company grade officers already experienced in their basic arms such as artillery, infantry, engineer. The Army figures that most of its missions call for flyers with a background of experience in the operations served by Army planes. These pilots are given frequent tours of ground duty to provide them with opportunities to keep up with progress in their basic arms.

There are still several areas of USAF-Army relationships that require closer coordination. Army feels it should control its aviation research, development and procurement. It is also dependent on USAF for tactical air support and the bulk of airlift required to provide genuine mobility.



DE HAVILLAND BEAVERS proved workhorse liaison plane in rugged Korea

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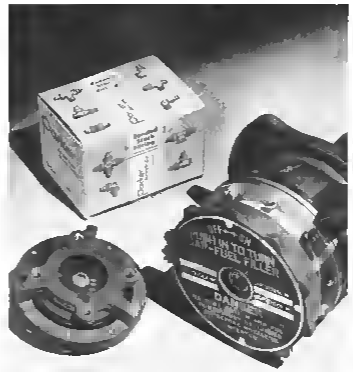

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■ NATO

Airpower is West's Weakest Link In NATO Defense Against Reds

(McGraw Hill World News)

Paris—High-ranking Allied officers have warned repeatedly during the last year that the greatest military weakness of the Western nations arrayed across the continent of Europe against the Communist East is in airpower. More than a volume of words, this brief warning points out the key role that airpower is expected to play in the defense of Western Europe.

Actually no responsible officer at Supreme Headquarters, Allied Powers in Europe (SHAPE) doubts that the Allied air forces could give an excellent account of themselves in any scrap with the Russians. The chances are the Communists would take a sound licking.

►**Good, But Not Enough**—But in this atomic world that is not good enough. Western strategy is based on achieving as nearly complete and absolute air superiority as possible. The West must be supreme in the air to protect Western cities from devastation and to afford its ground troops the cover and close support they certainly would need in order to hold back a massive Russian attack.

The nations of the North Atlantic Treaty Organization (NATO), of which SHAPE is the military headquarters, are steadily building an immensely powerful Allied air force in Europe. This force is still far short of the goal that has been set for it but it compares favorably with the force Russia could throw against it.

►**What Reds Have**—Allied intelligence estimates that Russia and her satellites have an air fleet of some 20,000 planes.

Of this total only 8,000 to 10,000 could be used in an attack against the nations of Western Europe because of the limitations imposed by the number of available airfields and by Russian commitments in the Far East and elsewhere.

►**What NATO Has**—NATO air forces now have a few more than 5,000 planes. This total will be increased 30% to about 6,500 planes by the end of this year.

These figures do not include U. S. strategic bombers in Britain and French Morocco, a substantial part of the British Royal Air Force, or eight squadrons of the French Air Force in France and North Africa which would be available in an emergency but have not been committed to NATO command.

The NATO air forces will be strengthened considerably this year, however, by the appearance of three new, high performance interceptors. The French Dassault Mystere and the British Hawker Hunter and Supermarine Swift all will begin going into squadron service before the end of the year.

It is estimated that the NATO air forces will get a total of about 3,000 new planes during this year. About half of these new planes will be used to replace older equipment. The other half will go to make up the planned increase to 6,500 planes in the NATO command.

►**This Also Counts**—But number of planes alone is a poor measure of the strength of an air force. Tactics, training and the intricate complex of ground services that support and direct the air force in action are at least equally important. And it is in this field of operational efficiency that the West could reasonably expect to hold the big advantage over a Communist enemy.

Allied officers here point out that the final box score of the Korean war shows the United Nations fliers shot down 13 or 14 enemy planes for every U. N. plane lost. At the same time, U. N. air forces dominated the sky over the battlefield so completely that it might be hard to find a U. N. foot soldier who ever saw an enemy plane.

Airmen believe this almost fabulous record is largely the result of the much greater operational efficiency of the U. N. air force. Experts concede that in the MiG-15 the Communists had a good plane. But they were weak in tactics, gunnery, training and ground operations.

►**Three-Years' Progress**—A major part of the buildup of the military strength of NATO nations during the last three years has been directed toward the goal of assuring that the West will enjoy the same margin of operational efficiency in the air as U. N. forces did in Korea. Excellent progress already has been made in this highly complicated task.

When Gen. Eisenhower assumed command of SHAPE three years ago, there were only 15 airfields on the continent of Europe capable of handling jet planes and available for military use. Now NATO has more than 120 airfields, and 40 more are programmed or

are being built at the present time.

Communications, too, have been vastly improved. Thousands of miles of landlines for exclusively military use have been laid, and a radio net with the most modern equipment has been put into operation. In addition, good progress has been made in standardizing communications procedures and training in all NATO nations.

To date NATO has spent about $1 billion on what is called "infrastructure"—airfields, communications facilities, barracks, etc. Another $500 million will be spent by the end of 1956. The lion's share of these funds has been earmarked for air force facilities with airfields as the largest single item.

► **Fuel Facilities**—This year NATO will spend $252 million on infrastructure, about half of it to complete underground fuel-storage facilities at NATO airfields and to build 3,750 miles of pipelines to carry jet fuel from ports on the Atlantic and Mediterranean to the network of airfields in northern France.

One of these new NATO pipelines will run from Marseilles up the Rhone valley. The other will begin at Le Havre and run east. They will supplement a third pipeline to be built exclusively with U.S. funds which will start at St. Nazaire and terminate at Metz.

These pipelines will be completed sometime next year. They will be connected to underground storage depots at airfields and at strategically located "fuel farms" which can serve several airfields. Fuel supply today is probably the most serious weakness of the NATO air forces.

► **All-Weather Fighters**—Another of NATO's major air problems, however, will not be so easily or quickly solved. This is the lack of all-weather fighters in NATO air forces. Airmen regard this as a serious weakness, but hold out little hope it can be corrected soon.

Allied officers here doubt that any USAF units equipped with F-94s, or other all-weather fighters, will be sent to Europe—at least for several months. The operation of all-weather fighter squadrons will require months of special training in the air forces of most NATO nations before such squadrons could go into service, even were the planes likely to be available soon.

► **Bomber Punch**—The air forces under NATO command include no long-range bombers and only a few light bombers like the British Canberra. The big offensive punch available to the West in an emergency is the American B-47, units of which are operating from bases in Britain and Morocco.

Although they are not under NATO command, these B-47s are a major element in the West's growing airpower

Missile Program Depends On What U. S. Can Afford

Re-evaluation of tomorrow's weapons shows that future costs of all present projects may be too great a drain on national economy.

By David A. Anderton

The entire future of guided missiles in this country hangs on a slender green chain of dollar bills.

The plain facts are that we cannot afford to produce all the missiles now in several stages of development throughout the country. We cannot afford to keep all the research and development establishments going to back up all the projects. We cannot afford to keep firing a myriad of special-purpose test vehicles. We couldn't possibly afford an all-out offensive with the new weapons.

In short, the missile has grown in 10 years from a cheap, expendable item made of low grade steel to a complex metallic organism which now compares in cost to a conventional airplane designed to do roughly the same job.

►**Old Problem, New Concern**—This isn't a brand new problem. Ever since there has been a missile program in this country, people close to it have worried as they watched costs skyrocket. They have always believed that no real results could ever be obtained from a missile program which disregarded the question of ultimate costs.

But no official action was taken on any overall basis. It remained for the "new look" in defense policy to stimulate a close scrutiny of the dollar value of the missile program.

Under the leadership of Trevor Gardner, special assistant for research and development in the USAF, a committee examined the expansive missile industry. They toured plants, talked to engineers and managers, heard presentations. Then they returned and wrote an interim report, now in the hands of Donald Quarles, assistant secretary of the Air Force for research and development.

That report is dynamite. It spells out life or death for every one of the half hundred missile or component projects currently under way in this country. It separates the sheep from the goats.

It contains the answers to the single simple question which determines future missile policy of the United States:

• What kind of missiles can we afford?

►**Long Overdue**—This kind of approach to the problem is long overdue, according to those in the missile business. In the postwar rush to get going on development and production of the awesome weapons of the future, there was little concern with ultimate costs. There was, in fact, little concern with any long-range planning.

Then K. T. Keller, chairman of the board of Chrysler Motors, was called in to handle the transition from research and development into production. His main mission was to get promising projects firmed up in tangible hardware.

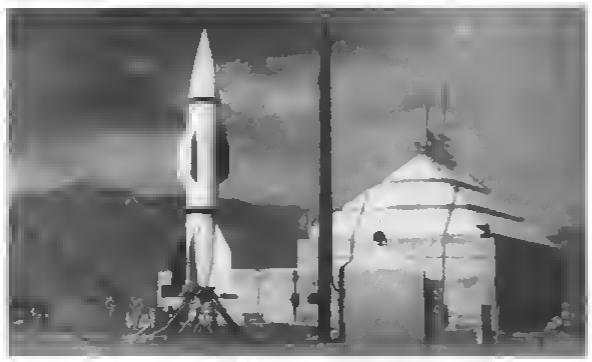
The industry was "Kellerized", immediate production was ordered for three missiles. Later, others joined the select trio. One of the last arrivals on Keller's list was Redstone, an Army Ordnance missile which is to be produced in quantity under a multi million dollar contract, by Chrysler.

Keller has since moved out, as quietly as he moved in. The fact that we have production quantities of some missiles today, and will have some more tomorrow, is due in great measure to his brute-force approach.

►**Gardner Group**—The first job of the Gardner committee was to find duplication in the Air Force guided missile program. That duty was later extended to cover the projects being carried on by all the services.

Still later, Gardner's committee was asked to consider overall economizing in the entire missile program. They were to name the most promising projects in research, development and production.

Details of the Gardner report are highly classified, as are most phases of the missile program. Some indication of the magnitude of the Gardner committee's work can be gotten from the accompanying tabulation of missile projects.



EARLY YIELD of postwar projects is Nike (left) and Hermes A-1 test vehicle.

B-61A MATADOR ROARS OFF zero-length launcher and into climb to cruise altitude. Speed is subsonic until final supersonic dive.

In more detail than the table permits, these following paragraphs describe some of the current missile programs.

Air-to-Air

Original concept of air-to-air guided and propelled missiles probably rates back to two tactical tricks used by Luftwaffe fighter aircraft during World War II. Kept at a respectful distance by the overlapping defensive firepower of the bomber box, the fighter planes used unconventional approaches.

Small unguided solid propellant folding-fin rockets known as the R4M were fired in salvo from a line abreast fighter formation either ahead or to one side of the bomber box.

Light fragmentation bombs with time-delay fuses were dropped into the bomber box from above.

Both tactics had limited success. The fighters were still too far away to achieve the necessary accuracy. So air-to-air weapons were rushed into development, and at the end of the war, there were several of these new type weapons that were undergoing tests at the Luftwaffe's experimental fields.

►**Postwar Missile**—In the United States, the first postwar work on AAMs was typified by Ryan Aeronautical's Firebird. This slim missile set the fashionable lines for most of those that came after. Measuring about 10 ft. long and 6 in. in diameter, Firebird achieved limited success. The program was completed, but the bird never went into production.

In general, this class of missile is intended to replace fighter or bomber armament. Related to the unguided aircraft rockets, AAMs are in a size and weight class with Firebird. Most of them use solid-propellant rocket motors and are unboosted. Speed at burnout of the rocket charge is about Mach 3.

Current missile projects include:

• Hughes F-98 Falcon, for the USAF. Now in production at Hughes' Tucson, Ariz., plant, Falcon is to be paired with the Convair F-102 interceptor as armament for the supersonic fighter. A typical installation of the Falcon would pair the missiles in underwing racks. Propulsion is provided by a solid-propellant sustainer rocket; top speed is Mach 3.

• Sperry Sparrow, for Navy BuAer. Actually there are several Sparrows, made by combinations of companies including Sperry Gyroscope, Raytheon Manufacturing Co., and Douglas Aircraft. Early versions have been built by Douglas, but main production is to come from Sperry's new plant at Bristol, Tenn. Sparrow used delta wings and tail in an early version, and weighed about 300 lb. Power comes from a solid propellant sustainer, and burnout speed is about Mach 3.0. Range is about five miles.

• Martin Oriole, for Navy BuAer. Reports identify this missile as a ramjet-powered, 1,500-lb bird, carrying a distance of 20 mi. at Mach 3. This is out of the usual size class of AAMs, but may represent a different approach to the problem of aircraft destruction. Size and range indicate that Oriole is intended to arm long-range interceptor aircraft, to knock enemy bombers, not fighters, out of the sky.

• Bell Meteor, for Navy BuOrd. Meteor originated under a contract with Massachusetts Institute of Technology for a missile, MIT was to call in other companies for development and production of laboratory items. In with MIT were Federal Telecommunications Lab, where the guidance system was de-

veloped, and Bell Aircraft Corp, where Meteor was to be built. The missile weighed about 500 lb, was propelled by a liquid-rocket engine and carried a 25 lb warhead at a speed of Mach 3.0. The project was reported canceled last summer.

Air-to-Surface

The only purpose of an air-to-surface missile is to give greater immunity to the attacking bomber by increasing the distance between the target and the point where the bomb load must be dropped.

Air Force developments such as Azon, Razon and Tarzon—which were free-falling bombs that could be steered by command signals from the drop aircraft—are not considered in the category of air-to-surface missiles. To qualify, an ASM has to have propulsion, guidance and lifting surfaces. Then it becomes a small pilotless bomber, consigned to one-way missions.

In addition to the Bell Rascal, Douglas Aircraft Co. has announced that it is working actively on an ASM, no further details have been released.

• **Bell B-63 Rascal, for USAF.** Rascal is a small, rocket-propelled aircraft that resembles Bell's X-1 research series. Launching gear similar to that used to drop the X-1 releases the B-63 from the mother ship about 100 mi. from target. After the drop, initial guidance is done by a preset programming device in the missile, midcourse and terminal guidance is by radar from the mother ship. Maximum speed exceeds Mach 1.5 (AVIATION WEEK Jan. 18, p. 18).

Air-to-Underwater

This category of missiles includes types designed solely to chase submarines. Launched from an aircraft, AUMs plunge toward the water and dive beneath the surface, homing on a submarine at high speed. Useless wings or other appendages may be sheared off on contact with the water, leaving not much more than a sophisticated torpedo to continue the hunt.

This approach was tried by the Germans during the war; their naval ordnance experts came up with a revised torpedo shape—divorced from the hemispherical nose so favored by U.S. naval

U.S. Guided Missiles

Category	Designation and name	Manufacturer	Service	Powerplant mfr and type	Max. range, mi.	Overall length, ft.	Body dia. ft.	Takeoff weight, lb.	Remarks
Air-to-Air (AAM)	F-98 Falcon	Hughes	USAF	s.p. rocket					Mach 3 speed
	Sparrow	Douglas	BuAer	s.p. rocket	5			300	Mach 3 speed; to be built in several versions
	Oriole	Martin	BuAer	Ramjet	20			1,500	Mach 3 speed
	Meteor	Bell	BuOrd	Lp. rocket				500	Mach 3 speed; cancelled
Air-to-Surface (ASM)	B-63 Rascal	Bell	USAF	Lp. rocket	100				Similar to Bell X-1; Mach 1.5 speed
		Douglas							
Air-to-Underwater (AUM)	Petrel	Fairchild	BuOrd	Fairchild J44 turbojet					For training only
Surface to Air (SAM)	Lark	Fairchild	BuAer	Reaction Motors Lp. rocket		14	1.5		Out of production
	Terrier	Convair	BuOrd	Aerojet s.p. rocket	10			3,000	For shipboard service; Mach 3 speed
	Nike	Douglas	ArmyOrd	Aerojet Lp. rocket,	20	20	1.0		Canard, delta surfaces; in service with Army
	F-99 Bomarc	Boeing	USAF	Ramjet/rocket				5,000	Winged & finned body; Mach 2.8 speed
	Loki	Bendix	ArmyOrd	Grand Central s.p. rocket					Finned body
	MX1598	Oerlikon		Lp. rocket		10	1.3		Swiss development under test in U.S.
Surface-to-Surface (SSM)	B-61 Matador	Martin	USAF	Allison J33 turbojet	500	30	4.5	12,000	In service with USAF; subsonic
	Corporal	Firestone	ArmyOrd	Aerojet Lp. rocket		30	2.3	12,000	Tactical missile
	Regulus	Vought	BuAer	Allison J33 turbojet		30	4.5		Swept-back, tailless
	Hermes Jaba	Douglas	ArmyOrd						Artillery rocket
	B-62 Snark	Northrop	USAF	Allison		32	4		Swept-back, tailless; subsonic speed; Long range
	Navaho	North American	USAF			80	5		Developed by German scientists in U.S.
	Redstone	Chrysler	ArmyOrd						Close-support use
	Lacrosse		Marines	Recoverecalling engine	5				Short-range
	Hermes A-3	General Electric	ArmyOrd	GE Lp. rocket					Project intact yet
	Rigel	Grumman	BuAer	Marquardt ramjet					
Test or Research	Aerobee	Aerojet	USAF; Navy	Aerojet Lp. rocket		20	1.5	1,800	Finned body layout
	Bumper	Douglas	ArmyOrd	Lp. rocket					V-2 plus WAC Corporal two-stage rocket
	Hermes A-1	General Electric	ArmyOrd	GE Lp. rocket		25	3		Based on German C2/E2 Wasserfall (SAM)
	X-7	Lockheed	USAF	Marquardt and Weight, ramjets					Engine test vehicle
	X-10	North American	USAF						Test vehicle for Navaho; first flight in February
	Viking	Martin	NRL	Reaction Motors Lp. rocket		42	4		Holds altitude record of 130 miles

NOTE: This list includes contemporary missiles and test vehicles which are either experimental, or in production or in service. No attempt has been made to list the many useful but outdated test vehicles such as the North American Nidiv or Cobra or early operational missiles, like the Navy's Bat.

Abbreviations:
ArmyOrd — U. S. Army Ordnance
BuAer — U. S. Navy Bureau of Aeronautics
BuOrd — U. S. Navy Bureau of Ordnance
NRL — Naval Research Laboratory
USAF — United States Air Force
Lp. — liquid propellant
s.p. — solid propellant

■ MISSILES

architects—combined with wings and tail sections which balanced and controlled the missile during its air drop. On impact, wings and tail sheared off, and the homing torpedo sped on alone.

There has been no official mention of any U. S. missile in this category, but at least one is known to exist:

▪ **Fairchild Petrel, for Navy BuOrd.** Powered by the lightweight, expendable Fairchild J44 turbojet, Petrel is one of a series of similar missiles named after diving birds. Design of the series originated with the National Bureau of Standards. Naval units have trained with Petrel, and production at Fairchild's Guided Missiles Division, Wyandanch, Long Island, has matched the need of training duties.

Surface-to-Air

Second in importance only to the long-range surface-to-surface missiles, the anti-aircraft weapons in this category range from the simplicity of Loki, an unguided solid propellant rocket, to the F-99 Bomarc, a complete air defense system of which the pilotless interceptor is only a part.

▶ **Active and Passive**—Guidance systems also run the gamut of sophistication. At one end is the "passive" type, characterized by extensive ground radars which do the work and tell the missile to go right, left, up or down. The beam-rider system is one example of this, in it, the bird rides the center of a radar beam, much as a twig drifts along the center of a stream.

At the other end of the scale is an "active" guidance system, which most engineers feel is too large to get into a missile. It would be a completely self-contained system, which could locate the target, and home on it without any reference to ground-collected data. This is the ultimate.

There is a middle ground, called "semi-active," a guidance schema used in the Fairchild Lark, as one example. Details have not been released, but one kind of semi-active system would call for firing the birds along a predicted flight path, laid out in the sky by data from a ground radar tracking the target. When the missile neared the theoretical intercept point, small internal homing radar would take over and guide the missile to the target.

These are the SAM projects of current interest:

▪ **Fairchild Lark, for Navy BuAer.** Rocket-propelled and featuring a semi-active guidance system considered by many to be ahead of its time, the Lark now is out of production. There are still a few rounds in the hands of training units. Lark used rectangular wings and tail surfaces rotated so that they were 45 deg. out of plane to each other. Powerplant was a Reaction Motors, Inc., liquid rocket engine. Speed was subsonic, limited to Mach 0.9. Complete analysis of the Lark was carried in AVIATION WEEK May 22, 1950, p. 12.

▪ **Convair Terrier, for Navy BuOrd.** Intended as a shipboard defense weapon, Terrier is one of a family developed under a Section T contract between Navy and the Applied Physics Laboratory of Johns Hopkins University. The contract, under the code name of Bumblebee, has produced a large number of test vehicles and at least three missiles—Terrier, Talos and Triton.

Terrier went into production at Convair's Pomona plant early in June 1951. It is a canard layout, with trapezoidal wings and control surfaces. Sustainer rocket motor is a solid propellant Aerojet unit. Weight is about 3,000 lb. with solid-propellant booster attached. Range is on the order of 10 miles, top speed is about Mach 2.

▪ **Douglas Nike, for Army Ordnance.** Originally designed to cope with bombers in the class of the Boeing B-29, Nike requirements never were updated to keep pace with technological developments. As a result, the missile is now ready for service in production quantities, but could not shoot down most of the enemy's bomber fleet. Chief value of Nike is as propaganda for the Army and to keep congressmen feeling safe, say some observers.

With slant range of 18 mi., Nike could only reach out to strike aircraft inferior to the Boeing B-47. Against a high-speed bomber, its performance would be doubtful. Nike, propelled by an Aerojet liquid-propellant rocket engine and needing a solid-fuel booster for launching, is built around a delta canard geometry. Guidance is beam rider. Cooperating firms are Douglas (airframe), Western Electric and Bell Telephone. (AVIATION WEEK Dec. 28, 1953, p. 13)

▪ **Boeing F-99 Bomarc, for USAF.** Bomarc is a complete air-defense system, involving much more than the development of the pilotless interceptor bearing the F-99 designation. An outgrowth of the GAPA program which was cut out from under Boeing in 1948, Bomarc has drawn heavily on the earlier ramjet and airframe development.

From the only picture released, Bomarc appears to have both rocket and ramjet powerplant. Layout is conventional, using a single trapezoidal midwing and trapezoidal tail surfaces. Weight is about 5,000 lb. and top speed is about Mach 2.5.

Judging by the layout, Bomarc banks in maneuvers, this concept is unique among missiles, which generally use two sets of lifting surface at right angles and

turn around one set or the other while the missile axes remain unmoved.

• **Bendix Loki, for Army Ordnance.** First developments on this project were based on the German WWII flak rocket Taifun, which was a simple, unguided rocket to be used in barrage fire. Layout is a simple finned body, and propulsion is a solid-propellant unit by Grand Central Aircraft Co.

• **Oerlikon MX 1868.** This anti-aircraft rocket was developed by the Swiss armament firm, and is reported to be under test in the United States. The missile has four cruciform wings mounted on a slender body at about the two-thirds point, no other surfaces are fitted for lift or control. A liquid-rocket engine powers the missile. Beam-rider guidance system was developed by Brown-Boveri, another Swiss firm. Range is reported to be about 12 mi.; speed is supersonic. First details of the missile were published in AVIATION WEEK Sept. 17, 1951, p. 18.

Surface-to-Surface

Surface-to-surface missiles offer the most serious competition to the entrenched weapons of each service: the Air Force strategic bomber, the Army artillery and the Navy aircraft carrier.

Under intense development by each service, SSMs have been designed for an extreme range of tactical and strategic uses. They will support Marine assault teams in close work on a beachhead or reach out over intercontinental distances to strike an enemy. They will smash troop concentrations or railroad yards under weather conditions which keep tactical aircraft on the ground. They will—but they won't just now.

▶ **Matador Squadrons**—To the Air Force goes the honor of activating the first guided missile squadrons. The 1st and the 69th Pilotless Bomb Squadrons, trained at Patrick AFB and the Air Force Missile Test Center, Cocoa, Fla., have been scheduled to go to Germany. Trained on B-61A Matadors, their service weapons will be a further refinement of Martin's missile, to be designated B-61B.

Close on Air Force heels comes the Army, with the announcement that two of its artillery missiles—Corporal and Honest John—will be used in field exercise Flash Burn scheduled for April and May.

▶ **New Approach**—There is one design trend which does not show in the examination of any lists of current SSMs. The ballistic missile, which does not fly through the atmosphere like a conventional aircraft but follows the parabolic trajectory of artillery shells, is coming in again for close scrutiny by planners and designers. The idea was passed over in favor of "flying" missiles because of the difficulties of terminal guidance and skin heating in ballistic missiles.

But gradually there has come the realization that only a ballistic missile is free from interception, even the V-2 of ten years ago could not be stopped by any technique known today except by knocking out the firing teams and sites. New approaches to cooling, new materials and new ideas have lessened the danger of premature bursts from overheated warheads.

There are more radical ideas to come in this type of missile and its importance will grow greatly during the next few years.

Meantime, these are the tactical and strategic missiles in our arsenal:

• **Martin B-61 Matador, for USAF.** Closely resembling a contemporary airplane without provision for a pilot, Matador has been a production item at Martin since December 1951 (AVIATION WEEK Oct. 5, 1953, p. 28). Thrust off by Rato from a zero-length launcher, Matador climbs to cruise-out altitude and speed of Mach 0.9, and dives supersonically into the target.

• **Firestone Corporal, for Army Ordnance.** Corporal design originated as one of a series of rocket-propelled test vehicles named after ranks in the Army and the Women's Army Corps (hence the WAC Corporal, the Private, Sergeant and Corporal). Powerplant is an Aerojet liquid-propellant rocket engine. The missile resembles the V-2, is about the same height (40 ft.) but only about 2.5 ft. in diameter. It is being built by Firestone Tire and Rubber for use by the Army Field Forces.

Many test and training rounds have been fired, and the first use of the missile in simulated support of ground troops is scheduled for the upcoming Flash Burn exercise.

• **Chance Vought Regulus, for Navy BuAer.** Comparable to USAF's Matador in size and performance, the Regulus differs in aerodynamic layout. It is a tailless bird, with highly swept wings and a nose inlet feeding its Allison J33 turbojet. Vought got a production contract last year for a quantity reported to be less than 200 birds.

A unique feature is that Regulus is returnable and uses wheeled gear to make conventional landings on conventional runways, as opposed to the skid landings of some AF missiles at Patrick AFB. Useful life of Regulus and its value as a test vehicle have been greatly increased through returnability. Length is about 30 ft., diameter about 4.5 ft., and weight probably around the 12,000-lb. level of Matador.

• **Douglas Honest John, for Army Ord.** This missile is called an artillery rocket by the Army, and probably is not a very complex beast. First official mention came in connection with announcement of Flash Burn.

• **Northrop B-62 Snark, for USAF.** For seven years, Snark (named from Lewis Carroll's nonsense poem in Alice in Wonderland) has been kept deep in the security thicket. It is a sweptback, tailless configuration powered by an Allison turbojet.

Snark capability may have been roughed out by John K. Northrop in testimony prepared for the President's Air Policy Commission in 1947. "... Know-how is presently available for the design of a 600-mph. missile with a range of 4,000 mi. or better ..."

• **North American Navaho, for USAF.** This program also is shrouded in a thick security blanket. But North American's huge rocket motor development installation at Santa Susana is a tipoff that Navaho depends on rocket propulsion for part of its flight. NAA work on air-bearing gyros provides the clue to long-range capability of the missile; air bearing gyros are practically frictionless, and have very small drift errors over a long time, thus aiding pinpoint navigation.

There is also a Navaho test vehicle, reported to be designated X-10, which made its first flight last month at the Air Force Flight Test Center, Edwards AFB, Calif.

• **Chrysler Redstone, for Army Ordnance.** Chrysler's part in this program calls for research, development and

■ MISSILES

production of the Redstone missile, originally designed by a group of ex-German scientists now in the U.S. at the Army's Redstone Arsenal, Huntsville, Ala. Part of Redstone's technical backlog was information on long range ramjet and rocket missile design turned over to the group by General Electric's Project Hermes. That experience may have found application in the Redstone missile.

• **Lacrosse, for the Marines.** This short range missile is intended for close support of Marine assault teams. It is powered by a reciprocating engine, has a range of about eight miles.

• **General Electric Hermes A-3, for Army Ordnance.** This designation applies to one of a series of Hermes missiles under development by GE engineers for Ordnance. Basic mission of the series is tactical. The Hermes project includes considerable basic development work in propulsion and guidance, as well as specific applications to missiles (AVIATION WEEK Mar. 8, p. 26).

• **Grumman Rigel, for Navy BuAer.** Another well-kept secret. Rigel, like Vought's Regulus, named after a first-magnitude star was a long-range missile design incorporating an integral Marquardt ramjet. Grumman says it now has no missile contracts, so it is presumed that Rigel is either inactive or was canceled.

• **Convair Atlas, for USAF.** This is a very long-range intercontinental ballistic missile drawing on Convair study and test program with the MX-774 project.

Test and Research

The test and research missiles are the workhorses. Unglamorous, even unappealing to the eye, the lowly test vehicle is the solid foundation on which many a missile program has built.

There have been wooden vehicles, boosted by a solid-propellant rocket to check rough flight characteristics during launching. Some have been small scale models of the big thing, as in the Hermes B tests. Some have been converted into missiles—the Corporal is one example.

Crammed with instrumentation and with warheads replaced by avionic gear, early production missiles have been pressed into service as test birds. There is an extreme view, held by many missile engineers, who say that every flight is a test flight.

▶ **Big and Small**—Any table of research missiles is necessarily incomplete. To a rocket engineer, a 5-in. aircraft rocket with a test probe and five channels of telemetered information is a test vehicle as much as is the 42-ft. aristocrat of test birds, the Martin Viking.

You simply can't list the hundreds of test vehicles under the Bumblebee program, which included Cobra (for "cobbled up ramjet," said one engineer) and one which was almost named Essobee, after the maker of the fuel it burned and as an indication of its behavior. Boeing's GAPA program expended many test rounds; NACA has conducted research with rocket powered vehicles for several years. There was NATIV (for North American Test Instrumentation Vehicle) and MX-774, a ballistic test missile by Convair.

Most of these have been made obsolete by changes in program or new wind-tunnels or improved methods of calculation. They flourished in the early postwar missile period.

Today these are the test and research missiles of interest:

• **Aerojet Aerobee, for USAF, Navy and Army.** Aerobee has been used since 1947 for a variety of jobs mostly connected with upper-atmosphere research. It is 20 ft. long, 15 in. in diameter, weighs 1,690 lb. including the booster at takeoff. Aerojet developed the rocket and its engine, a liquid-propellant type (AVIATION WEEK Feb. 1, p. 30).

• **Douglas Bumper, for Army Ordnance.** Douglas built the modified nose of the V-2 rocket which served as the first stage of this two-stage high-altitude prober. Original design came from the Jet Propulsion Laboratory at CalTech, passed through the ex-Peenemunde scientists then at Ft. Bliss, Tex., and went to General Electric, where project responsibility was placed.

Bumper is a combined WAC Corporal and V-2, at burnout of the V-2, the WAC is fired and its velocity and altitude performance are added to those of the V-2. Bumper round No. 5 established a 250 mi. altitude record; successful Bumper rounds were the first two-stage liquid-propellant rockets ever fired. (A four-stage solid-propellant missile, Rheinbote, had been built and fired by the Germans during the war.)

• **General Electric Hermes A-1, for Army Ord.** The A-1 was a missile test vehicle for surface-to-surface missiles developed on the Hermes project, but rather peculiarly was built to the design of a German anti-aircraft missile, the C-2 E-2 Wasserfall. Two changes were made in the layout. Wasserfall's wings were clipped and the air rudders were of different shape. Internally everything was different. A few rounds were built and tested by GE.

• **Lockheed X-7, for USAF.** This is reported to be an engine test vehicle for Marquardt and Wright Aeronautical ramjet engines.

• **North American X-10, for USAF.** This is a test vehicle for the North American Navaho missiles probably intended for development of the guidance system.

• **Martin Viking, for NRL.** This Vik-

ing has probably the best success record of any of the current crop of missiles. Manufactured on a build and fly basis by Martin for the Naval Research Lab, the Viking design stays fluid so that latest test information can be fed back into the layout of the next round. Viking was completely changed with round No. 8, its fineness ratio was reduced and delta fins replaced the trapezoidal ones. The single-stage rocket altitude record of 136 miles is held currently by Viking.

What About Tomorrow?

All these are milestones on a missile road which stretches back about 10 years in time and at least four billion dollars in money. None of the missiles in production today is operational at anything like the effectiveness expected by its designers.

But if we had to push the button tomorrow, we could send some missiles off in the direction of the enemy. To that extent, there has been progress.

But what of the industry needed to back up a large-scale use of these missiles? Could the country produce enough hydrazine in the future to justify designing a missile around that propellant now?

How many J57 turbojets can we afford to build and throw away with only one using? How many electron tubes? How much platinum, gold, silver, tungsten, copper, chrome, cobalt?

In short, what is the guided missile going to cost—not per unit—but per offensive?

VIKING 9 heads for altitude record.

First jet to jet refueling, accomplished with Probe and Drogue equipment built by Flight Refueling Inc.

TUPOLEV-200

ILYUSHIN-38

Aviation Week Sources Behind Iron Curtain Reveal . . .

Reds Put Muscle on Strategic Air Arm

Production of two new turboprop bombers, continuing replacement of obsolescing planes, and new development projects underline formidable airpower effort.

The Russians are putting a major development and production program behind their slowly growing strategic bombing force in an effort to develop a formidable capability for delivering atomic and hydrogen bombs on intercontinental targets.

Although the bulk of the operational Russian bomber strength now based in the European and Asiatic Arctic is still piston-engine Tupolev-4 types copied from the Boeing B-29, a new turboprop bomber similar to the Convair B-36 is already in squadron service and another sweptwing turboprop bomber is in production (Aviation Week Feb. 15 p. 12).

At the same time the long-range bomber production program is swinging into high gear, facilities of the Russian and Communist satellite factories that have been turning out the MiG-15 fighter at an astonishing rate are being re-tooled for large scale production of a new jet fighter.

This buildup in the offensive strength of Red airpower was predicted exclusively in this magazine more than three years ago (Aviation Week Feb. 26, 1951, p. 17). It has been conducted at great speed and under rigid security conditions. The closely guarded bomber development program has produced two new intercontinental weapons:

• **Tupolev 200.** This long range heavy bomber is powered by six turboprop engines and greatly resembles the Convair B-36. The Tu-200 also features a radar bombing system. This bomber is already in squadron service, but estimates of the total number produced vary from less than 100 to several hundred.

• **Ilyushin-38.** This is a new sweptwing bomber powered by four turboprops of the same type used in the Tu-200. The Il-38 is also equipped with a radar bombing system and is known to be in production. It falls about midway between the Boeing B-47 and B-52 in size.

These two advanced designs are backed up by a fleet of about 700 aging but operational Tu-4s, Tupolev's copy of the Boeing B-29.

This Tu-4 fleet is now deployed at bases on Kamchatka and other peninsulas reaching out from the Soviet mainland into the Arctic toward North America. It is backed by a reserve of several hundred additional Tu-4s not assigned to operational units.

But the Reds have not neglected the defensive aspects of airpower in favor of the bomber fleet. During the past few months these seven new Russian designs have been reported by Aviation Week sources behind the Iron Curtain:

• **Lavochkin 17 modification for ground support,** powered by a single turbojet and carrying a two man crew. Armament is four 23 mm. cannon.

• **Ilyushin 28-2 light bomber,** developed as a major modification from the Il-26 series. Plane is now sweptback, but otherwise resembles its predecessor.

• **MiG-17 all-weather fighter,** radar-nosed twin-jet modification of the MiG 15 of Korean fame. Plane mounts four 23 mm. cannon.

• **Lavochkin flying-boat fighter,** a two seat, single jet waterbased craft.

• **Rocket interceptor,** based on the Junkers 8-263, a production development of the German Me-163.

• **All-weather fighter** with swept-forward wings, drawing heavily on German wartime research on sweptwing design. Plane has two jets, spans about 68 ft.

• **Delta wing medium bomber,** powered by four turbojets and spanning about 65 ft. This new design, together with the rocket interceptor and swept forward fighter, are under development by a team of ex-German designers headed by top Heinkel engineer Siegfried Guenther. The team works at the Red experimental station at Podberesje.

▶ **Regular Roster**—These new airplanes are not all operational. Currently the Red air force and naval units are flying about 40 different types of fixed and rotary wing craft in Russia and the satellites. Some of the aircraft are new, like the turboprop bombers. Some are becoming obsolescent like the MiG-15 and the Il-26 series. Some are completely outmoded, such as the Pe-3 medium bomber.

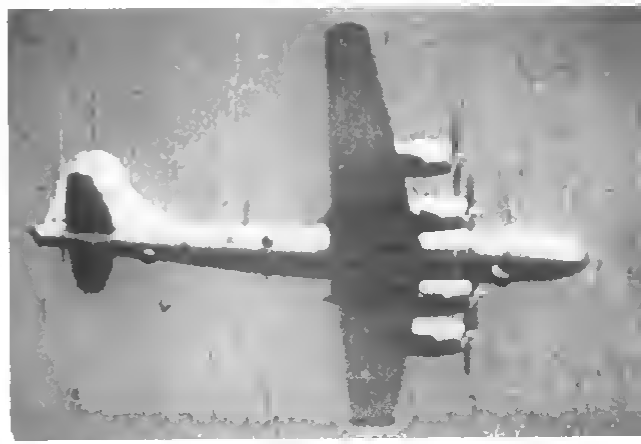
Probably no more than a dozen of these 40 types are in actual production in the Soviet Union today.

To these piloted aircraft must be added the uncertain strength of Russian missile developments. Reported at every level, from the mere copying of inferior German wartime weapons to the service status of intercontinental multi-stage rocket missiles, the Red pilotless aircraft program presents a cloudy intelligence enigma.

Greatest defensive strength of the Red air force is still in the huge numbers of MiG 15 variants scattered throughout the Communist sphere of influence. More than two thirds of that strength is the older MiG-15 used in Korea. A newer model with afterburner and a gunsight based on North American F-86 Sabre equipment is in squadron strength and replacing the older model. The MiG-17 twin-engine fighter is just coming into squadron service with the Reds.

The MiG 15 production program provided a surprising demonstration of Russian ability to manufacture modern highspeed jet aircraft. Although factories in the satellite countries were employed to augment Russian fighter production, the total MiG 15 output far exceeded the total production of the United States, Canada and Australia on the North American F-86

MIG-15



TUPOLEV-4

Sabre for the same period.

The Russians also put the MiG-15 through several model improvements during this large-scale production program, comparable to the Sabre development from F-86A to F-86F.

In addition to equipping the Red air force fighter squadrons, the MiG-15 production program also provided thousands of this swept-wing fighter for the Czech, Hungarian, Polish, Chinese and North Korean air forces. The production program for the Il-28 was also of sufficient magnitude to provide the satellite air forces with substantial quantities of this twin-jet bomber that has tactical atomic capabilities over an 1,800-mile range.

▶**All-Weather Units**—Two Red designs, handle the night-fighting aspects of defensive warfare—the Il-26, and new MiG-17s. Reports reaching AVIATION WEEK indicate that the Russians are using airborne interceptor control techniques in their simulated home-defense missions.

The control center is the old Po-2 bulging with radar gear. It cruises near its maximum altitude and vectors the MiGs toward the target. Recent maneuvers of the Red air force tested the efficiency of this method.

One controversial item on the Red roster is the rocket-propelled fighter. There have been repeated reports of interceptor developments based on the German Messerschmitt 163, which was later turned over to Junkers for production redesign as the E-263.

According to these reports, squadrons of the rocket fighter are in service. But AVIATION WEEK sources say that the development program for these unusual planes is turned on and off, depending on how the winds of top-level policy blow.

As of June 1953, this development program was being pursued, but there were no airplanes in service. Later in the fall, the entire program was cancelled.

It is not known yet whether work is under way again.

▶**Ground Support**—Indications are that the Reds were slow in providing new designs for ground support, the traditional task of their air service. Until the end of 1953, all ground support units were equipped with Il-10s—slightly modernized versions of the old Stormovik of World War II—and with Po-2s, another old aircraft.

Recently the La-17 long-range fighter has been adapted for the job of ground support. Rebuilt into a solid-nosed, two-place attack craft, the La-17 is entering squadron service with the Russians.

Apparently this aircraft, built as a backstop at the same time the MiGs were in production, never measured up to the standard interceptor.

The La-17 saw limited service in Korea during the winter of 1951-52 but did not distinguish itself in air-to-air combat with the Sabre.

Older model MiG-15s are also being assigned to ground-support duties in considerable number.

One of the unsolved puzzles of Russian aviation is the scope and effectiveness of their pilot training program. It is obvious that a large quantity of well-trained pilots is required to man the fighter forces, in addition to the growing demand for aircrews to operate the steadily increasing bomber fleet.

Some indications of serious deficiencies in training were evident in Korea where the general skill level of pilots encountered by USAF Sabre pilots was low, and in the extremely limited number of flying hours logged by the two Polish MiG-15 pilots who fled to Denmark with their planes.

The training problem for aircrews capable of handling long-range gas-turbine powered bombers and radar bombing systems is even more complex as USAF's Strategic Air Command can testify. However it seems safe to assume from the determination and effort poured into the solution of other Russian aviation problems that whatever pilot deficiency now exists may not persist for long.

▶**Light Bombers**—The Russians erred in their selection of the Type 150 for tactical bombing. Developed as a much reworked version of a Junkers wartime design, the Type 150 never lived up to its advance performance calculations.

As a stopgap measure, the Il-28 was modified by the replacement of its straight wing with a swept planform and the installation of engines with about 10% more thrust (AVIATION WEEK Jan. 11, p. 14).

Most squadrons have been equipped with the straight-wing Il-28 for some time; the newer Il-28-2 sweep-wing modifications are being rushed into service as long-overdue replacements for the straight-wing bomber.

▶**Naval Units**—Latest reports say the Russians have three aircraft carriers in operation. Most of the planes are MiG-15s with arresting gear; a few older dive-bombers complement the MiGs.

Other than the one prototype flying boat fighter observed last year (AVIATION WEEK Aug. 24, 1953, p. 11), no new water-based aircraft have been reported.

There is a new torpedo bomber of recent vintage—tentatively designated the Tu-12—which is land-based. It resembles the Il-28 series, and carries two 20-in. torpedos in its slim fuselage.

The Il-4, used for the torpedo task during World War II, has been relegated to training status.

▶**Helicopters**—Two neat helicopter designs, credited to Mikhail Mil, have appeared in recent air displays at Moscow's Tushino airport. Both are single-engine, single-rotor craft, resembling the Sikorsky S-51 and S-55 externally.

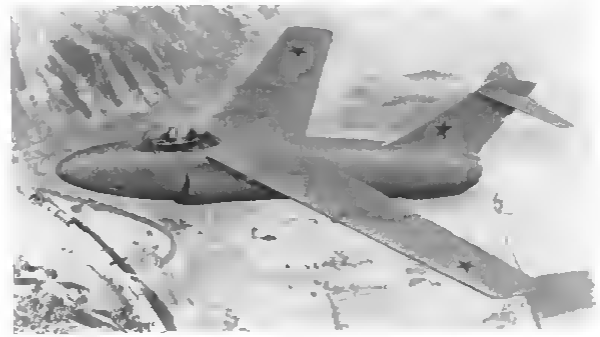
There have been no reports of helicopters in military service in Russia or the satellites. Liaison and communication tasks continue to be handled by a collection of venerable biplanes and monoplanes in the 100-hp. category.

This picture of Red air strength shows a steadily and in some cases spectacular growth of a modern gas-turbine powered air force backed by engineering and production effort required by the tremendous technical advances of post-war aviation. American observers of the Russian aviation scene still tend to underestimate gravely the Soviets' technical skill, production capacity and the tenacity with which they are carrying out their publicly announced policy of trying to build an air force second to none.

One of the factors that can easily throw an American view of Russia out of focus is the simple fact that while only a relatively small portion of American technical skill and productive capacity is being used for the development of air-atomic capability, a much higher percentage of available Russian resources is being applied to the same problem. In absolute measurement of effort devoted to military airpower the Russians may well be exceeding our own.

Emergence of the Russian strategic air force is the end result of only 10 years of development. It is an accomplishment that has been a rude jolt to technical observers this side of the Iron Curtain. That jolt is even harder for U.S. experts to take when their con-

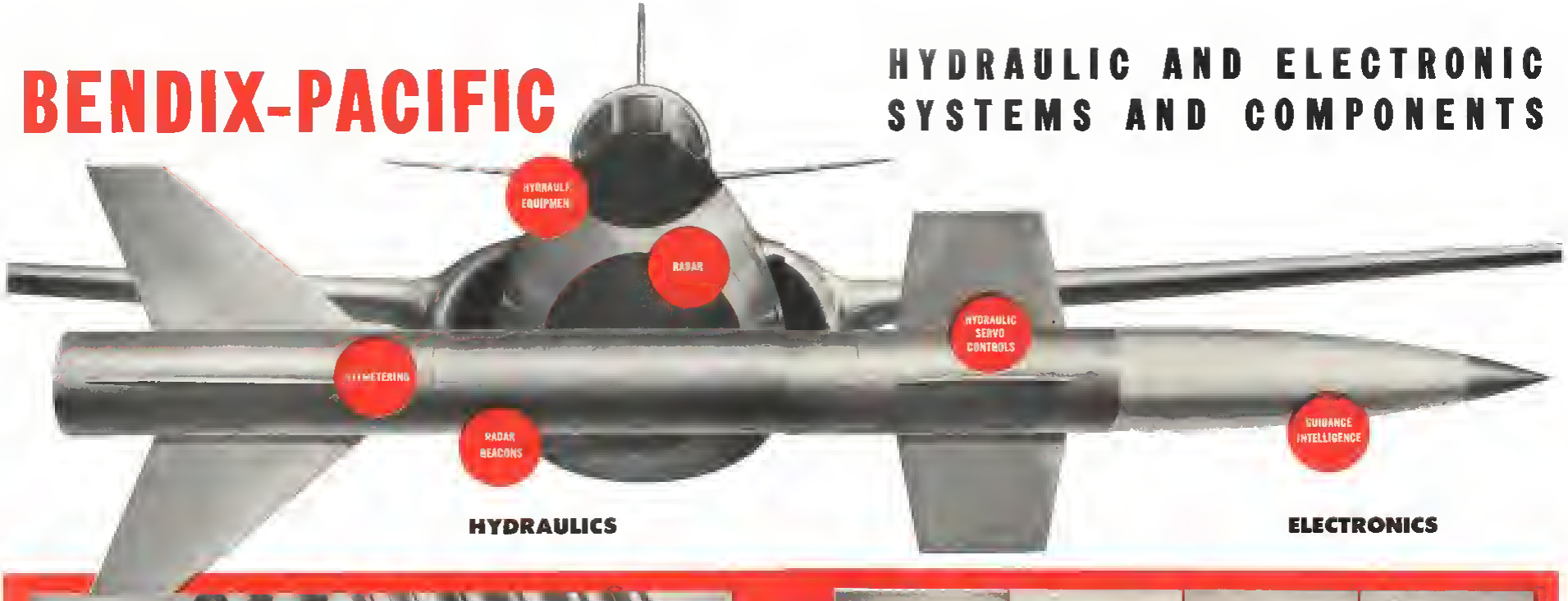
MIG 17

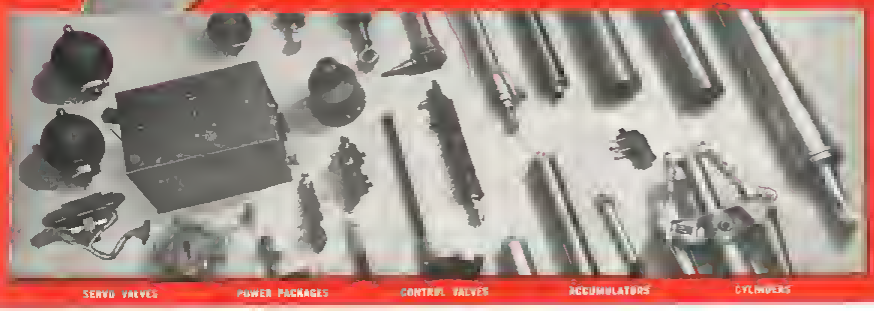


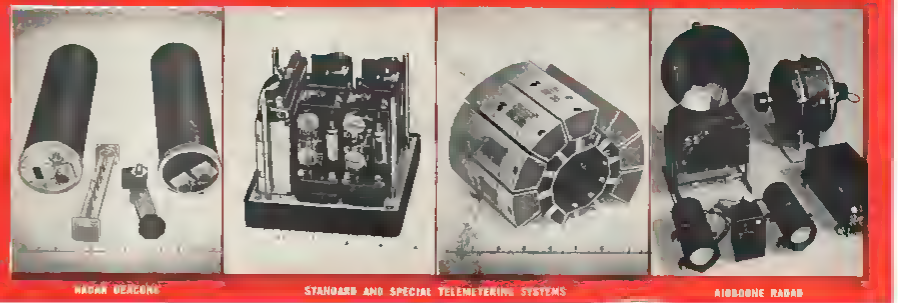
LAVOCHKIN 17-2

BENDIX-PACIFIC

HYDRAULIC AND ELECTRONIC SYSTEMS AND COMPONENTS







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■ RUSSIAN AIRPOWER

sider the immense drain of engineers, manpower and material that went into the purely defensive aspects of Russian airpower, the buildup and supply of the Communist air forces in the satellite countries, and the replacement of air materiel in Korea

The new policy was adopted toward the end of World War II by top Russian military brass During that conflict, the Russian air force managed to mount very few bombing raids on Germany Those efforts showed them their weakness The joint US-British strategic bombing that blasted German industry into rubble showed them what airpower could do

The atomic bombs that rocked Hiroshima and Nagasaki supplied the final lesson

Linked by tradition to the ground support mission, the Russian air force broke its time-forged chains in the immediate postwar period in time to ride the crest of the jet-powered technical revolution that forced all of the great nations of the world to build their airpower anew To aid Russian technology, a sizeable portion of German engineers and scientists were imported and have made substantial contributions to the growth of the postwar Soviet air force

In retrospect it is easy to discern the tremendous effort Russia has devoted to building its postwar airpower—an effort about which the United States has been duly warned but still tends to underestimate

Since 1946 the Russians have built a fleet of long-range piston bombers equivalent to our B-29s, which are still in active service with SAC. They have produced a jet fighter force that boasts more modern sweptwing interceptors than the combined NATO powers. They have built a military air transport system equipped with twin and four-engine planes to link their extensive airbase network.

They are now well along on building a fleet of gas-turbine-powered long range bombers capable of carrying the atomic and hydrogen bombs also developed by Soviet scientists.

But just as in the case of the atomic bomb the Russians did not ignore the chance to brag about their strength

An unnamed Russian general, writing in the official Moscow newspaper Izvestia,' says this

'In the United States, a great deal is written on the so-called global, intercontinental or trans-ocean strategy The authors of these theoretical exercises picture a war as if their adversaries had no means of embarking on this kind of strategy

"Would it not be wiser to assume the opposite?"

s in current volume production by Ketay

ROL TRANSFORMERS

OLTAGE RATING	OPERATING FREQUENCY	ELECTRICAL ACCURACY MAX. ERROR
26/11.8 VAC	400	34 SPD
26/11.8 VAC	400	30 SPD
90 1V per deg	400	±7
11.8 32 VAC	400	28 SPD
16 V-11 Input	400	
11.8/22 VAC	400	15 SPD
90/1V per deg	400	±10
11.8 22 VAC	400	20 SPD
90/1V per deg	400	±10'
90/1V per deg	400	±8'
90/1V per deg	60	±8
90/1V per deg	400	±8
90 1V per deg	60	±8
90/1V per deg	60	±18
90/1V per deg	400	±6'
90/1V per deg	60	±6

unit

ntrol Transmitter 26/11.8 VAC

SYNCHRO RECEIVERS

TYPE	FRAME SIZE	FUNCTION	MK	MOD	VOLTAGE RATING	OPERATING FREQUENCY	RECEIVER ERROR MAXIMUM
K101540	10	Torque Receiver			26/11.8 VAC	400	1 5°
K402020	15	Torque Receiver			115/90.3 VAC	400	76'
K101430	15	Torque Receiver			36/11.8 VAC	400	76'
15TR4A	15	Torque Receiver	16	1	115/90 VAC	400	1 0°
16TR84	16	Torque Receiver			115/90 VAC	400	1.0°
18TR4A	18	Torque Receiver	16	1	115/90 VAC	400	1.0°
19TR84A	19	Torque Receiver			115/90 VAC	400	1.0°
1F	1	Torque Receiver	8	0	115/90 VAC	60	1 5°
23TR4	23	Torque Receiver			115/90 VAC	400	1 0°
23TRe	23	Torque Receiver			115/90 VAC	60	1 0°
31TDR4	31	Torque D Harmonic Rec	19	1	90/90 VAC	400	48'
31TDR6S-1	31	Torque D Harmonic Rec			90/90 VAC	60	*[1]
31TDR6	31	Torque D Harmonic Rec			90/90 VAC	60	48'
31TR4A	31	Torque Receiver	18	1	115/90 VAC	400	48'
31TR6	31	Torque Receiver	22	0	115/90 VAC	60	48'

*[1] 31TDR6S1—Pigmil Unit Sensitivity 10'

13 14 15 16 17 18 19 20

MOTORS

FREQUENCY	MINIMUM NO LOAD SPPPD (RPM)	MINIMUM STALL TORQUE (OZ. IN.)
60	3000	3
60		75 at) 115 MF) 8V CF
60	3200	16

1) SYNCHRO Size 16 Frame O.D. 1.750 (Transmitter, Receiver, Differential Transmitter, Control Transformer)
2) INDUCTION MOTOR Size 16 Frame O.D. 1.750 3 Phase 2 Pole
3) SERVO MOTOR Mk II Size 16 Frame O.D. 1.75
4) SYNCHRO Size 19 Frame O.D. 1.90 (Transmitter, Receiver, Control Transformer)
5) INDUCTION MOTOR Size 20 Frame O.D. 1.95
6) SYNCHRO Type 1F, 1HGT or 1HG Size 1 Frame O.D. 2.250 (Receiver Transmitter, Control Transformer)
7) INDUCTION MOTOR Size 1 Frame O.D. 2.250
8) SYNCHRO Size 23 Frame O.D. 2.250 (Transmitter, Receiver, Resolver, Differential Transmitter, Control Transformer)
9) SERVO MOTOR Size 23 Frame O.D. 2.250
10) SYNCHRO Size 31 Frame O.D. 3.10 (Transmitter, Receiver, Differential Receiver, Differential Transmitter)

SYNCHRO TRANSMITTERS

TYPE	FRAME SIZE	FUNCTION	MK	MOD	VOLTAGE RATING	OPERATING FREQUENCY	ELECTRICAL ACCURACY MAX. ERROR
K101580	10	Control Transmitter			26/11.8 VAC	400	24 Spd
K101550	10	Control Transmitter			26/11.8 VAC	400	24 Spd
K101570	10	Control Differential Trans.			11.8/11.8 VAC	400	30 Spd
10182J	10	Control Transmitter			36/11.8 VAC	400	20 Spd
11CX4a	11	Control Transmitter			115/90 VAC	400	±7
K101350	15	Control D Harmonic Trans.			11.8/11.8 VAC	400	20' Spd
K101490	15	Control Transmitter			26/11.8 VAC	400	20' Spd
K101430	15	Control Transmitter			36/11.8 VAC	400	20 Spd
K101480	15	Control Differential Trans			11.8/11.8 VAC	400	20 Spd
15DDX4a	15	Torque D Harmonic Trans	28	1	90/90 VAC	400	±10
15CDX4n	15	Control D Harmonic Trans	33	1	90/90 VAC	400	±10'
15CX4n	15	Control Transmitter	22	1	115/90 VAC	400	±12'
K101420	15	Control Differential Trans.			11.8/11.8 VAC	400	20 Spd
16CX54a	16	Control Transmitter		1	115/90 VAC	400	±12
18CDX4n	18	Control D Harmonic Trans.	34	1	90/90 VAC	400	± 8
18TDX4n	18	Torque Differential Trans.	29	1	90/90 VAC	400	±12
18CX4n	18	Control Transmitter	32	1	115/90 VAC	400	± 8'
18CX6a	18	Control Transmitter	46	8	115/90 VAC	60	±12
19CDX6	18	Control Differential Trans.			90/90 VAC	60	±10
19CX84a	19	Control Transmitter	38	1	115/90 VAC	400	±8'
1HG	1	Torque Transmitter	14	8	115/90 VAC	60	±18'
23CX4	23	Control Transmitter			115/90 VAC	400	±8
23CX6	23	Control Transmitter			115/90 VAC	60	±8
23CDX4	23	Control Differential Trans.			90/90 VAC	400	±8
23CDX6	23	Control Differential Trans.			90/90 VAC	60	±8
23TX4	23	Torque Transmitter			115/90 VAC	400	±8
23TX6	23	Torque Transmitter			115/90 VAC	60	±8
23TDX4	23	Torque Differential Trans.			90/90 VAC	400	±8'
23TDX6	23	Torque Differential Trans.			90/90 VAC	60	±8'
31TDX4	31	Torque Differential Trans.	36	0	90/90 VAC	400	±8'
31TDX6	31	Torque Differential Trans.			90/90 VAC	60	±8
31TX4a	31	Torque Transmitter	35	1	115/90 VAC	400	±8'
31TX6	31	Torque Transmitter	42	0	115/90 VAC	60	±8'

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*2) 23R

(1)
(2) r
(3) Ge

MASS PRODUCTION of aircraft and components like these Boeing B-47 wing panels will reach postwar high this year.

Aircraft Manufacturing

New Doctrine Aims to Stabilize Industry

Peak deliveries scheduled for this year with gradual decline to plateau level in 1956. Future net incomes may surpass record year of 1953.

For the first time in its turbulent postwar history the aircraft manufacturing industry can look forward to a period of relative stability and high sales volume.

Aircraft manufacturing will reach its postwar high-water mark during 1954. The floodtide of military orders stimulated by the Korean crisis should reach its crest of deliveries to the Air Force, Navy, Marines and Army this year and then begin a gradual decline in 1955 to reach a maintenance and modernization level in 1956. With few exceptions, airframe, engine, parts and accessory manufacturers already have enough business in their current backlogs to keep their plants busy until 1956.

During 1953 the aircraft manufacturing industry built about 155 million airframe pounds, of which only 10 million pounds represented civil aircraft. About 12,000 military planes were delivered, in addition to some 4,700 commercial transports and utility aircraft.

▶**More Airframe Weight**—During 1954 the number of military aircraft deliveries will remain at about the 1953 level but airframe weight will continue to increase by another 10%, as a higher percentage of heavy transports and jet bombers swell the military delivery total.

Sales, which reached about $9 billion during 1953, will continue to climb during 1954, paralleling the increase in airframe weight. A decline of perhaps 15% in gross sales looms for 1955, but that year's sales level should still be above the extremely prosperous year of 1952.

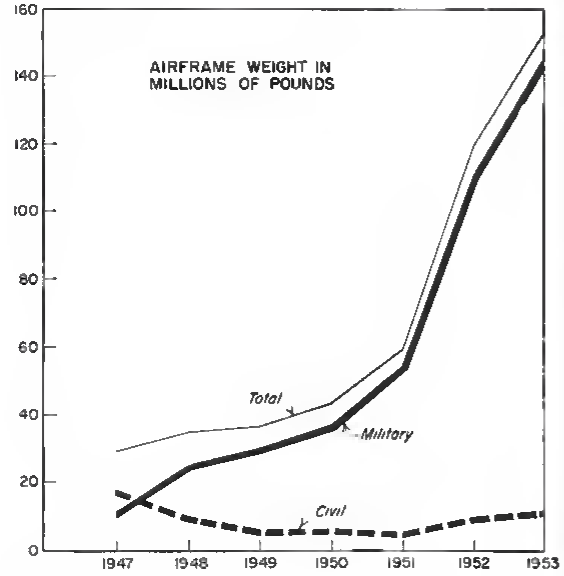
With the expiration of the excess profits tax on Dec. 31, 1953, and prospects for more liberal tax approaches to such key items for aviation managements as depreciation on facilities, and research and development expenditures, and a new determination of allowable costs, it is not unlikely that net income for the industry will surpass even the record mark of 1953 in succeeding years, despite a gradual decline in total sales volume.

▶**Military Market**—The military market will continue to be the key to the economic health of the aircraft industry.

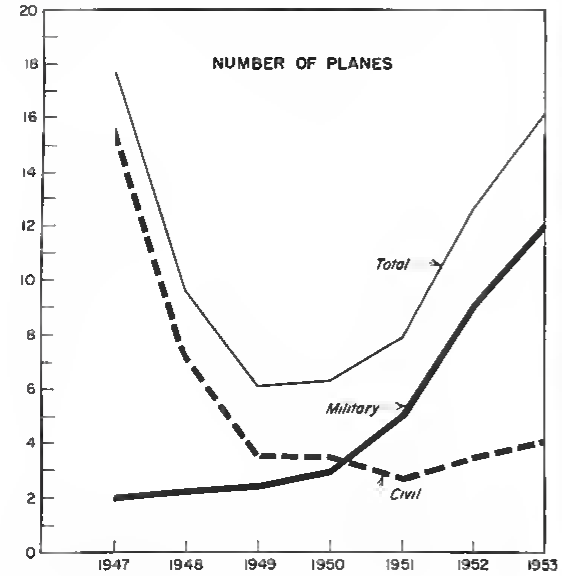
Here is the outlook for military business under new airpower doctrine of the Republican Administration that submitted its first federal budget (covering the fiscal year 1955) early this year.

The aircraft industry still is working on a large part of the $40 billion appropriated for aircraft procurement in the three fiscal years after the outbreak of war in Korea. On Jan. 1, 1954, the Defense Department ledgers carried a total of $27 billion in appropriated but unexpected funds for aircraft procurement. This represents work already contracted for with the industry but still not delivered or paid for. These same ledgers also showed a total of $7.6 billion available for new aircraft procurement contracts in 1954.

▶**Level Stays High**—Actual spending by the Defense Department for military aircraft (out of the $27 billion unexpended balance) is programmed for $9.3 billion in fiscal 1954 ending next June 30 and $9.1 billion for fiscal 1955. This compares with $7.5 billion spent in fiscal 1953 and $5 billion in fiscal 1952. According to Defense Depart-



Weight delivery rate of aircraft in postwar years



Aircraft delivery rate in thousands of planes

ment figures, the aircraft industry will enter fiscal 1956 on July 1, 1956, with a backlog of about $17 billion in military aircraft procurement.

For an industry whose total military sales volume was about 10% of that figure as recently as 1950 this is still a pleasant prospect.

▶ **What's Ahead**—While Defense Department expenditures are the best index of current business in the aircraft industry, the new obligational authority requested for aircraft procurement in each budget offers the best clue of what is likely to happen two and three years hence. By watching new obligational authority for aircraft procurement it is possible to chart a curve sliding downward from the peak of the Korean crisis to the level at which the aircraft industry is likely to settle.

Contracting by the military reached a peak in 1953, when about $12 billion worth of orders were given to the aircraft industry. For fiscal 1954 a total of about $7.7 billion is scheduled for new aircraft contracts, while fiscal 1955 is programmed for $6.5 billion in new military aircraft business.

This $6-billion annual aircraft procurement level, plus another billion for missiles and special avionics devices not included in aircraft costs, is about where the aircraft industry will probably emerge in 1956 after the post-Korean buildup. In dollar volume this is about two thirds of the post-Korean peak but more than three times the level of the pre-Korean industry of 1950.

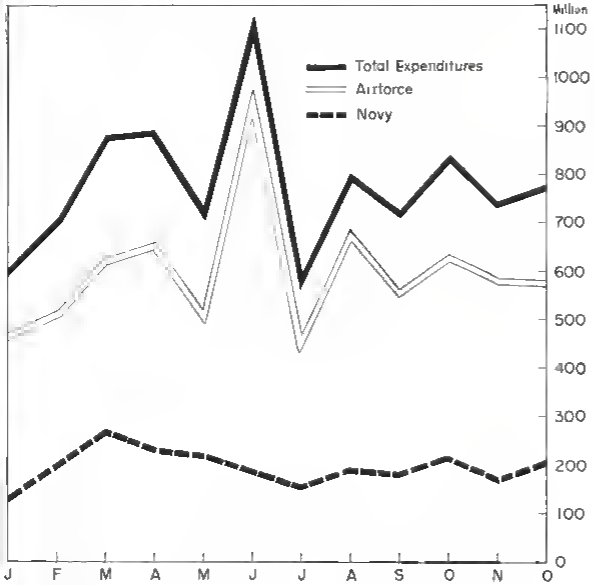
This $6 to $7-billion annual level is clearly forecast in the fiscal 1955 budget, because this is the first budget since the Korean war began that is based solely on a maintenance and modernization rate for the aircraft strengths already authorized for the Air Force, Navy, Marines and Army. All of the funds required for the expansion to these strength levels have been provided in previous years' appropriations (fiscal 1951-54).

▶ **5,500 Planes a Year**—Present plans call for financing about 5,500 new planes annually, to be split among the services as follows:

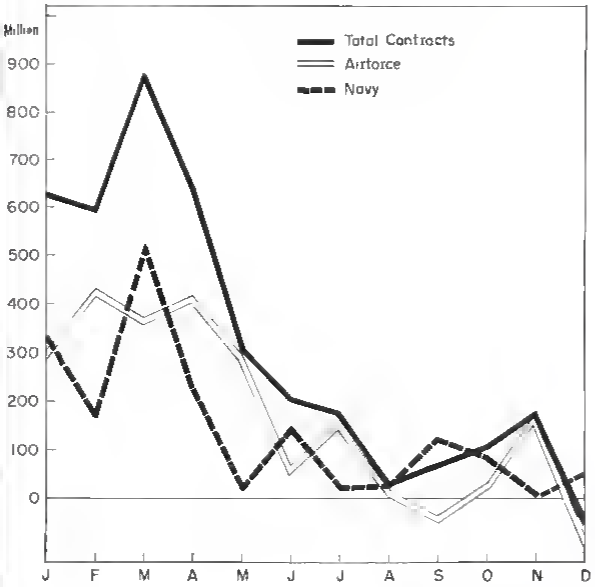
- USAF—3,600 planes and about $4 billion.
- Navy—1,600 planes and about $2 billion.
- Army—About $50 million.

▶ **A Backward Look**—At the end of 1953 the manufacturing industry could look back on a period as hectic as its frantic expansion to meet the demands of World War II. The expansion triggered by the Korean war gave the industry the double burden of expanding military airpower and at the same time modernizing it to meet the technical requirements of the jet era. Looking back it is now possible to measure the im-

Expenditures against contracts in 1953



Dollar value of new aircraft contracts in 1953



pact of this dual requirement. Here are some of the things that happened:

• **Production.** Output climbed from a 1950 total of 3,000 planes, most of them piston powered, to 12,000 planes, over half of them jet powered in 1953.

• **Employment.** Total employment soared from 257,000 workers in 1950 to 750,000 in 1953.

• **Facilities.** Slightly more than $3.5 billion was invested in new facilities between 1950 and 1953. This compares with $3.8 billion in new facilities during the wartime period 1940-45. During the 1950-53 expansion 34% of the new facilities (about $1.2 billion) were privately financed in contrast to about 10% ($420 million) during the World War II expansion. About 66% of the post Korean expansion was for tools and production equipment with 34% devoted to new plants.

• **Plants.** Plant area increased from 63 million sq. ft. in 1950 to more than 128 million sq. ft. at the end of 1953.

► **New Look.**—With the end of actual fighting in Korea and the buildup of production facilities virtually completed it was possible for the incoming Republican Administration to take a new look at the military aircraft production picture and organize a new program aimed at meeting the requirements for maintaining a superior national airpower over a 10 to 20 year period instead of the frantic mobilization to meet the threat of another world war that was expected in 1954.

The new program, designed to unscramble a number of tangles created by the air of urgency in the post Korean expansion and meet the new airpower doctrine organized by the National Security Council and President Eisenhower, has produced these trends:

• **A further stretchout** in production schedules.

• **Cutbacks** in future orders for obsolescing aircraft types and more emphasis on increased production of newer types.

• **Tighter policy on procurement** of airframe and engine spares.

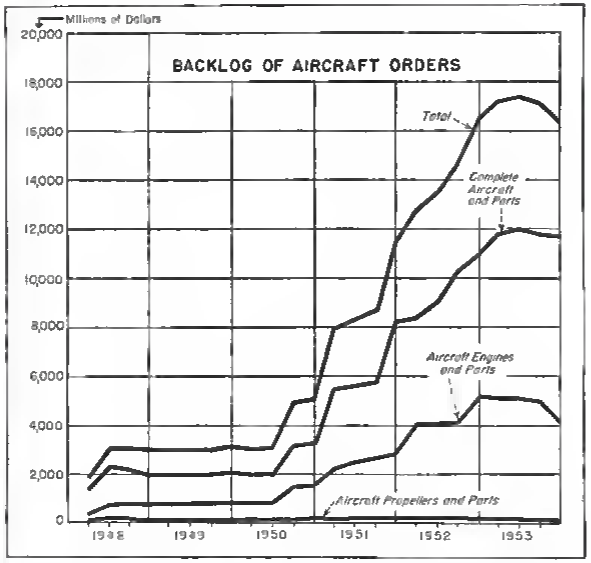
• **Harder bargaining** on new aircraft procurement contracts.

• **Heavy pressure** on industry to reduce production costs and return to normal production operations.

• **Narrowing the production base** back to the original aircraft industry and elimination of most second source producers on major airframes and engines.

• **Increasing emphasis on technical competition** and proved performance in contrast to "blue-sky" engineering promises.

• **Trend toward development** of complete weapons systems rather than individual items of hardware such as aircraft, armament, maintenance equipment, etc.



▶ **Tailored to Fit**—The current stretchout of production schedules has been done on a company by-company basis tailored to meet each particular firm's problems rather than by universal ukase in the manner of the Truman Administration stretchouts The aim is to get production schedules on a realistic basis that can be handled by companies with a normal work week and will keep their production and engineering forces occupied until new models phase into the program

A good example of how this works is the B 47 production program—largest on USAF schedule—at Boeing, Douglas and Lockheed plants in Wichita, Tulsa and Marietta The B-47 production has been stretched by about 12 months in each plant This time will permit Boeing Wichita to phase into B-52 production Douglas will have time to phase into production on its B-66 bomber at Tulsa, and Lockheed will follow its B-47 with its C-130 turboprop transport

In each case there will be a minimum loss of production workers between programs If earlier schedules had been followed, there would have been a gap of about 12 months during which the production forces would have had to be reduced and then rebuilt for the new programs

This principle has been applied throughout the industry on the basis of information furnished the military by each company on its individual problems. The net result has been to slice a portion off the production peak formerly scheduled and push it forward to fill in the bottom of the valley that loomed after the peak had been passed. This should add a strong element of stability to an industry that has been badly plagued by peak-and-valley production curves

▶ **Business Basis**—Another characteristic of the new Pentagon approach to aircraft manufacturers is an attempt to get military procurement back on a hard business basis after the hurried and necessarily wasteful practices of the Korean emergency Main factors in this trend are

• **Abandonment of letters of intent** except as an emergency procedure Both USAF and Navy are still working hard to reduce the tremendous backlog of letters of intent accumulated in 1951 and 1952 when the pressure was heaviest to pour money quickly into aircraft No letters of intent are being used for new obligations except for emergencies such as modification programs

• **Return to fixed-price** and incentive target-type contracts Pentagon is putting the pressure on contractors to negotiate these types of firm contracts before new procurement funds are obligated This puts both the Pentagon and the contractors in better bargaining positions

U. S. AIRCRAFT INDUSTRY, 1953

TOTAL EMPLOYMENT (in thousands)

	Aircraft	Acft. Engines & Parts	Props & Parts	Other Acft. Parts & Equipment	Total
January	447.8	158.1	16.3	99.2	721.4
February	448.1	163.7	16.6	100.8	729.2
March	449.2	165.6	16.5	103.7	735.0
April	446.9	159.2	16.5	104.7	727.3
May	445.6	161.3	16.4	105.1	728.4
June	444.5	165.9	16.4	106.8	733.6
July	447.6	167.9	16.3	109.1	740.9
August	453.1	168.2	16.3	112.1	749.7
September	457.7	170.4	16.7	113.4	758.2
October	455.9	172.1	16.5	112.2	756.7
November	430.2	168.4	16.6	111.3	726.5
December*	430.2	168.4	16.6	111.3	726.5

* Estimated
SOURCE: Bureau of Labor Statistics

U. S. AIRCRAFT INDUSTRY, 1953

PRODUCTION AND RELATED-WORKER EMPLOYMENT (in thousands)

	Aircraft	Acft. Engines & Parts	Props & Parts	Other Acft. Parts & Equipment	Total
January	326.9	115.0	12.1	76.7	530.7
February	329.3	118.4	12.3	78.1	538.1
March	330.2	119.1	12.3	80.7	542.3
April	327.2	112.6	12.2	80.8	532.8
May	324.8	114.5	12.1	80.9	532.3
June	321.8	118.3	12.1	82.6	534.8
July	322.3	118.9	12.0	83.8	537.0
August	328.1	119.6	11.8	85.8	545.3
September	334.6	121.5	12.2	87.1	555.4
October	331.0	123.4	12.1	86.5	553.0
November	303.3	119.1	12.1	85.5	520.0
December*	303.3	119.1	12.1	85.5	520.0

* Estimated
NOTE: Figures are for employees involved in or closely connected to actual production operations
SOURCE: Bureau of Labor Statistics

U. S. AIRCRAFT INDUSTRY, 1953

LABOR TURNOVER (per 100 employees)

	AIRCRAFT Separations	AIRCRAFT Accessions	AIRCRAFT ENGINES & PARTS Separations	AIRCRAFT ENGINES & PARTS Accessions
January	3.1	3.5	2.9	6.8
February	3.3	3.3	3.1	5.0
March	3.6	3.7	4.2	3.3
April	3.6	3.4	4.0	3.6
May	3.9	3.6	4.3	3.8
June	4.6	5.4	3.5	5.3
July	3.7	4.7	3.5	3.8
August	3.7	4.7	4.1	3.9
September	5.2	4.8	3.8	4.0
October	3.5	3.7	3.9	3.7
November	2.3	3.6	3.7	2.4
December	1.7	2.7	2.0	2.2

	AIRCRAFT PROPELLERS & PARTS Separations	AIRCRAFT PROPELLERS & PARTS Accessions	OTHER AIRCRAFT PARTS & EQUIPMENT Separations	OTHER AIRCRAFT PARTS & EQUIPMENT Accessions
January	1.8	5.5	3.8	5.5
February	2.9	2.6	3.2	4.8
March	2.8	3.1	4.2	5.2
April	3.3	2.8	3.9	5.0
May	3.1	2.4	4.0	5.0
June	2.1	3.2	4.1	5.9
July	1.9	2.5	4.3	4.7
August	1.9	2.0	4.5	5.3
September	2.7	2.1	5.5	4.1
October	1.9	2.6	4.4	2.6
November	2.4	2.9	3.5	2.5
December	1.0	.7	3.7	2.9

SOURCE: Bureau of Labor Statistics

U. S. AIRCRAFT INDUSTRY, 1953

AVERAGE HOURLY EARNINGS

	Aircraft	Acft Engines & Parts	Props & Parts	Other Acft. Parts & Equipment	Total
January	$1.96	$2.04	$2.06	$1.95	$1.98
February	1.96	2.02	2.07	1.96	1.98
March	1.98	2.01	2.01	1.97	1.99
April	1.98	2.00	2.03	1.97	1.98
May	1.97	2.00	2.02	1.96	1.98
June	1.97	2.02	2.06	1.98	1.99
July	1.97	2.03	2.04	1.99	1.99
August	1.99	2.04	2.06	2.00	2.00
September	1.99	2.05	2.05	2.02	2.01
October	2.01	2.06	2.05	2.02	2.02
November	2.02	2.06	2.06	2.02	2.03
December*	2.02	2.06	2.06	2.02	2.03

* Estimated
SOURCE: Bureau of Labor Statistics

U. S. AIRCRAFT INDUSTRY, 1953

AVERAGE WEEKLY HOURS

	Aircraft	Acft. Engines & Parts	Props & Parts	Other Acft. Parts & Equipment	Total
January	42.6	45.1	44.7	43.4	43.3
February	42.3	44.3	44.0	43.7	43.0
March	41.5	43.7	41.7	43.8	42.3
April	41.5	42.7	41.3	43.2	42.0
May	41.1	42.9	41.3	42.5	41.7
June	40.7	42.0	41.1	42.3	41.2
July	40.9	42.7	41.5	42.4	41.5
August	41.4	42.6	41.6	42.4	41.8
September	40.7	42.7	41.7	42.1	41.4
October	41.1	42.5	41.3	42.5	41.6
November	41.2	42.1	41.2	42.4	41.6
December*	41.2	42.1	41.2	42.4	41.6

* Estimated
SOURCE: Bureau of Labor Statistics

• **Conservative policy on progressive payments.** Pentagon feels that some manufacturers were allowed to build excessive inventories. It will now monitor all future payments of this type to make certain they fall within the strict intent of the law. Progress payments are permissible under USAF contracts. They are specified in Navy contracts, but policy will be more stringent than it has been.

• **Reduction of overtime operations and subcontracting.** Both of these items are expensive and add considerably to aircraft costs.

▶ **Keener Competition**—Although the aircraft manufacturing industry as a whole will prosper for at least the next two years, the fortunes of individual firms will fluctuate with the quality of their products. The technical revolution that began with the advent of jet power is still in full swing and manufacturers who fail to match its pace with their products will inevitably pay the penalty of falling sales. Never was technical competition keener nor the market for new ideas more bullish in the aircraft business. During the hectic post-Korean months virtually every aircraft in prospect was ordered into quantity production to meet the anticipated major crisis year of 1954.

Now that emphasis has shifted to building airpower for the long pull, the emphasis is on quality first and quantity second. Both USAF and Navy's Bureau of Aeronautics hatched some notable technical turkeys when the emphasis was on quantity at any price and both are now taking a much more conservative technical approach to their new equipment buying. For example, USAF is currently deferring several large procurement obligations for quantity production of particular aircraft until initial flight tests have yielded sufficient technical data to indicate the planes can perform as promised.

It is inevitable that some manufacturers who have done well in the era when virtually everything was being procured will suffer when this technical performance squeeze is applied.

The pace of aircraft development is still moving so fast that companies who are going well today may be far down the gross sales list in another three to five years. Firms who are still small today but well equipped with aggressive scientific talent well attuned to military requirements may also mushroom with equal speed and move up into the top brackets.

▶ **"Feast or Famine" Problem**—Ever since the sound recommendations of the Presidential Air Policy Commission headed by Thomas K. Finletter dissipated in a political fog during the 1949-50 Democratic economy wave, the aircraft industry has been plumping for a long-range aircraft procurement policy to avoid the "feast and famine" so shockingly demonstrated twice in the last 15 years. The full import of how tremendously expensive this "feast and famine" cycle is in terms of taxpayers' dollars has never been adequately demonstrated either to the taxpayer or the representatives they elected to Congress.

▶ **Six-Prong Attack**—In the meantime the Aircraft Industries Assn. has recommended a specific six-point program to both the government and industry to reduce production lead time and the cost of military aircraft procurement. These points are:

• **New contracting techniques.** Substantial savings on aircraft already in production can be realized if manufacturers are authorized to place advance orders for long-lead-time components.

• **Streamlined approval procedures.** Armed services procurement regulations now require too many essential manufacturers operations to be deferred until they are specifically approved by the military procurement officials. Time required for these approvals varies from a week to three months and increases the cost of the end item and the time necessary to deliver it.

• **Reduce the number of change-orders.** More thorough evaluation of aircraft prototypes would eliminate the need for many change orders that are issued during the early stages of large-scale production.

• **Maximum simplicity** commensurate with performance requirements. Efforts toward standardization of certain aircraft parts and components would decrease production time and cut manufacturing costs.

• **Increase production process engineering.** Present regulations limit the amount of money a manufacturer can spend on "process engineering" during execution of a production contract. This limits the development of improved manufacturing techniques that are basic factors in cutting both cost and time.

• **Production stability.** More airpower can be obtained at less cost by a stable production program than by the astronomic funds poured into "crash" programs in order to meet various international crises.

SHAPE OF THINGS TO COME in military avionics includes giant closed-loop super systems, typified by Project Volscan traffic control system developed by AF Cambridge Research Center. Photos show ground-based radar (left) and electronic computers (right) used with "data link" for automatic transmission of instructions to aircraft and for controlling their flight paths

Avionics and Airpower

New Techniques Buttress Avionics' Role

Trend toward giant super systems, coupled with tiny microtronic devices and developments in automation, indicates what's ahead in military avionics.

By Philip Klass

Three major trends in military avionics development, application and manufacturing stand out among the significant advances and disclosures of the past year.

- **Giant super systems,** for air defense, tactical air support, traffic control and landing.
- **Microscopically small construction,** using radically new techniques, to reduce greatly avionic equipment size and weight.
- **Automatic-factory-type** production of avionic equipment.

Super Systems

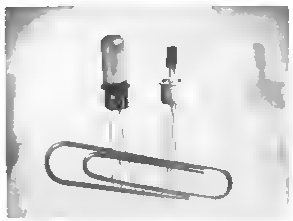
The day of the military pilot flying as a free agent in search of a target of opportunity is fast disappearing. If military aircraft are to carry out their increasingly important role in the national defense, they must be controlled like chessmen from a command headquarters which has up-to-the-instant information on the disposition of enemy air and ground targets, as well as its own aircraft.

▶ **Avionics' New Role**—Providing centralized information and control—accurately and precisely—is the important role of avionics in military airpower. This is increasingly true for continental air defense and tactical air support. It is the need for centralized information and control centers that is responsible for the coming era of super systems.

The super systems will employ many radars or other sources of intelligence (either ground-based or airborne), vast communications networks to feed such intelligence into ground-based or airborne control centers, batteries of digital computers to analyze raw data, display boards to picture graphically the tactical situation, and finally, a data link to transmit automatically information to aircraft and control their flight path or point of bomb release.

▶ **Systems Under Development**—An increasing portion of our military budget is going into the development and procurement of super systems for air defense and tactical air support. Largest and most complex of these, for continental air defense, are being developed under the AF Cambridge Research Center and Massachusetts Institute of Technology's Lincoln Laboratories. Many avionic manufacturers and several other military establishments and universities are playing prominent roles in the system development.

Tactical air control systems, being developed under the Rome Air Development Center, are the first super-system attempt to apply the latest avionic technology to the difficult problem of ground support.



MICROTRONIC construction techniques under development will permit major size and weight reduction in complex airborne equipment. New Philco technique for making transistors is one step.

AUTOMATIC FACTORY for avionics has come faster than expected. Photo shows one step in process at Navy-National Bureau of Standards' pilot plant, now in operation. Signal Corps and USAF also have automation programs.

■ AVIONICS

In one sense, these TAC systems will be miniature air defense systems designed to protect tactical areas from enemy air attack. However, they must also provide for ground support operations and be designed for maximum mobility and quick setup, requirements that are not imposed for continental air defense.

▶ **Super System Forerunner**—Several months ago, USAF's Air Research & Development Command took the security wraps off Project Volscan, a nearly automatic traffic control system developed by its Cambridge Research Center (AVIATION WEEK Dec 28, 1953, p 38). It provides a look at the nature of the super systems to come.

Volscan's specific mission is to convert a cloud of randomly arriving jet aircraft, returning to base with near-empty fuel tanks, into an orderly stream so that each plane arrives in proper close-order sequence without delays at low altitudes where fuel consumption goes up by a factor of three.

Volscan consists of:

- **Search radar**, which spots all aircraft returning to an airdrome.
- **Automatic trackers** (Antracs), which isolate and track individual aircraft blips, thereby converting a search radar into many tracking radars.
- **Schedule computer**, which calculates earliest, non-conflicting time of arrival for each aircraft.
- **Flight path computers**, which calculate flight path each plane must fly to arrive at scheduled time and provide continuous signals indicating required airplane heading and altitude.

When Volscan was demonstrated to the press, the flight path computer instructions were relayed by human operators over voice radio. The next step, which has already been tried experimentally, is to employ a radio "data link" which automatically transmits individual flight path computer instructions to the appropriate aircraft's instrument panel or its automatic pilot. In the latter case, the flight path computer will automatically maneuver the airplane onto the required flight path by means of its automatic pilot, fully closing the ground-to-air loop.

▶ **Closed-Loop Systems**—From a functional standpoint, a closed-loop Volscan operating through a data link shows the pattern of future super systems. The problem which Volscan solves is admittedly less difficult than trying to vector interceptors to fast-moving targets, or accurately pinpointing frontline ground targets.

From the standpoint of techniques, the TAC and ADC systems may employ digital computers instead of the analog types used throughout Volscan.

▶ **New Digital Computer Role**—The growth of super systems has created an important new role for large electronic digital computers, which may easily overshadow their first use as extremely high-speed versions of conventional calculating machines.

This is the application to "real time" problems, such as traffic control, fire control, missile guidance, and air defense, which were previously in the exclusive domain of analog computers.

(The terminology of "digital" and "analog," widely used to distinguish between the two types of computers, is somewhat ambiguous, since digital computers function as analog devices when solving real-time problems. Despite this, the terminology will be used here for lack of better names.)

A real-time problem is one in which the computer receives essentially continuous data on the parameters of an ever-changing problem from which it calculates continuously an up-to-the-instant solution. For example, a radar might supply a computer with information on the bearing, height, and distance of enemy bombers and our own fighters, from which the machine would compute continuously the required intercept heading and rate of climb.

▶ **Must Be Speedy**—To solve real-time problems, digital computers must be extremely fast, have suitable storage registers to hold changing input-output data momentarily. One machine with such capabilities is the 4,500-tube ERA 1103, developed by Engineering Research Associates Division of Remington-Rand for undisclosed use by the Defense Dept. (AVIATION WEEK May 11, p. 67). Rem Rand says the machine can perform 14,000 additions per second, 4,000 multiplications per second.

More recently, two real-time computers which are small enough for use in large aircraft have been announced by Jacobs Instrument Co. (AVIATION WEEK Feb 1, p 45). The smaller of the two is capable of handling nine variable inputs, providing three variable outputs.

All major digital computer manufacturers are believed to be working on airborne or ground-based real-time computers for defense needs, in addition to the general-purpose machines which are playing increasingly important and useful roles in the aircraft, avionic, and other industries.

▶ **Digital Communication**—The vast communication networks which form the lifestream of the super systems impose new demands on a radio spectrum already bulging at the seams.

Information theory developed in recent years shows that voice communication using conventional amplitude modulation is extremely wasteful of spectrum bandwidth. By converting speech into coded pulses (called "digital communication") for transmission, in-

dividual channel bandwidth can be compressed from 3,000 cps to 100 cps or less. This means that 30 times as many channels can be provided within the same band.

There are a variety of ways in which speech can be pulse-coded. The AF Cambridge Research Center is digging deeply into the subject to devise a versatile system in which spoken words can be pulse-coded and then decoded automatically into printed words.

If successful, a command spoken at an air defense center would appear instantly as a printed message in remote air defense centers and in teletype-equipped aircraft. (An airborne teletypewriter under development by the Wright Air Development Center is expected to weigh less than 50 lb including tape cutter and transcriber.) All words will be spelled phonetically, i.e., "fonetikly."

Meanwhile, work on less sophisticated forms of digital communication is being sponsored by the Rome Air Development Center. One of its contractors, Melpar, Inc., has developed a speech synthesizer which constructs intelligible speech from a pulse code having a bandwidth of only 75 cycles.

► **Pulse-Coding Advantages**—The ability to transmit oral commands instantly to far-flung sites in the form of printed instructions can prevent misunderstanding, save precious minutes in the event of an enemy attack.

In addition to convenience, speed, and reduced bandwidth requirements there is another important advantage. Pulse-coded messages can be scrambled in a wider variety of ways than is possible with present communications systems to prevent an enemy from deciphering them.

► **Data Link**—Several systems of transmitting information (not voice) by pulse-code modulation are presently under development or test at AFCRC, Rome Air Development Center, and in the Navy. The advantages of pulse-coded transmission of command and control information, called "data-link," are reduced bandwidth (or reduced transmission time) and the ability to operate with a poorer signal-to-noise ratio.

Data link is intended to enable tactical and air defense centers to control the flight path or bomb release point of individual aircraft via its automatic pilot. Data link will also be used to flash command instructions to pilots on a special cockpit instrument.

► **Handling Super Systems**—Advent of super systems has forced organizations like RADC, AFCRC, and some manufacturers, to set up groups whose sole task is to supervise and coordinate development of the many complex sub systems which make up a super system. For example, RADC has created a 100-man systems division to assure subsystem compatibility and the tactical usefulness of its super systems.

AFCRC set up a separate systems project section after it found that its important research efforts were being diverted to systems work. Cambridge has now divided its electronics division roughly in half, with one group devoted to systems work, the other to research and component development.

► **Tough Assignment**—Finding engineers with a sufficiently broad background for super-systems work is difficult. They need experience in radar, communications, computers, flight control, and tactics.

However, "it is in systems engineering that the real challenge to young engineers lies," R. J. Nordlund of WADC's armament lab has said. Nordlund calls it "the most broadening of any phase of the profession."

Microtronics

If avionic systems are getting larger, the basic electronic building blocks are getting smaller, as well they must, particularly for airborne use. There is increased emphasis on developing radically new components and construction techniques which are microscopically small, compared with the best previous sub-miniature techniques. AFCRC, which is sponsoring some of the work in this field, calls it "Microtronics."

► **Triggered by Transistors**—The transistor, tiny vacuum-tube replacement invented six years ago by Bell Telephone Labs, triggered the microtronic movement, both with its own capabilities and by stimulating interest and research in the semi-conductor field.

At first blush, the transistor's potential advantages of small size, light weight, low power consumption-heat dissipation, long life, made it appear to be the answer to the avionic engineer's prayer. But even after transistor manufacturers had learned, the hard way, that hermetic or improved sealing was needed for long trouble-free transistor life, there proved to be several other limitations to its use in avionics.

• **Low operating temperature.** Germanium transistors were generally limited to operation at temperatures below 70C, practically all avionic equipment must be designed to operate in ambient temperatures of 85C, frequently higher.

• **Low frequency.** Except for experimental four-element (tetrode) transistors, the device could be used only at frequencies up to a few megacycles, greatly limiting its radio-frequency applications.

• **Low power rating.** Maximum power rating of production transistors was in the order of a few tenths of a watt.

• **Limited availability.** Because of lab-

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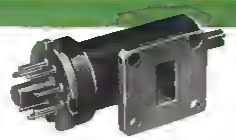

LOCAL OSCILLATOR SKU-55

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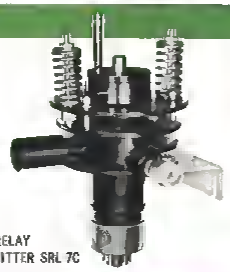
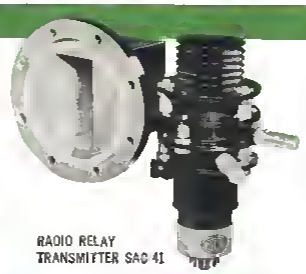
RADIO RELAY TRANSMITTER SRC 43

RADIO RELAY TRANSMITTER SAC-19

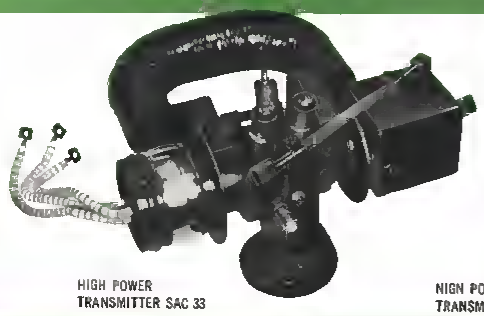
HIGH POWER TRANSMITTER SAS-29



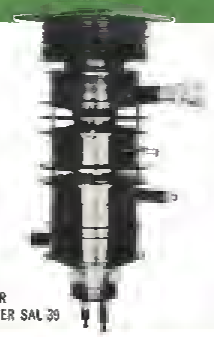
RADIO RELAY TRANSMITTER SRL 7C



RADIO RELAY TRANSMITTER SAC-41



HIGH POWER TRANSMITTER SAC-33



HIGH POWER TRANSMITTER SAL-39

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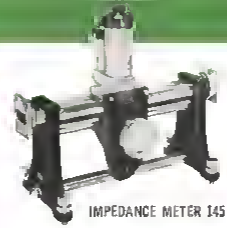
DETECTING SECTION 364

MIXER 337C



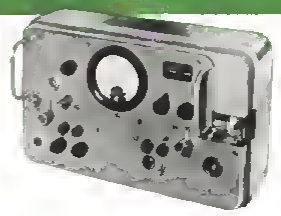
IMPEDANCE METER 145

DIRECTIONAL COUPLER 209

FREQUENCY METER 288

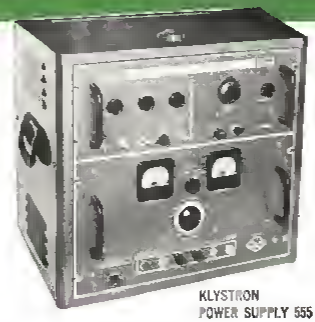
WAVEMETER 537

RADAR RANGE CALIBRATOR UPM 11



VSWR TEST SET 539

RADAR TEST SET 38A



KLYSTRON POWER SUPPLY 555

On these pages, only one item in each product line is illustrated. Also included in the Sperry line [illegible] are the following additional Microline instruments: Bolometer and Thermistor Mounts, Barretter Elements, Impedance Transformers, Terminations, Adapters, Wattmeter Bridges and Adjustable Shorts. For complete details write our nearest distributor.

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oratory type manufacturing techniques —including assembly under a microscope—transistor makers had trouble producing sizable quantities of improved units with sufficiently uniform characteristics

▶ **Significant Development**—One of the most significant transistor developments of the past year came several months ago when Philco Corp disclosed a radically new manufacturing technique which holds promise of easing many previous limitations (AVIATION WEEK, Jan 4, p 50). Philco has

SURFACE BARRIER technique developed by Philco for making transistors by using tiny streams of liquid is step toward microtronic construction

introduced two innovations with its "surface barrier" technique

• **Fluid jet etch.** Two tiny streams of etching solution are simultaneously directed coaxially against opposite sides of a small pellet on semi-conductor material, with a potential of several hundred volts between the jets and the pellet In less than two minutes, the jets have etched two pits in the pellet leaving a thin bridge of semi-conductor material only 0 0002 in thick

• **Electroplated junctions** When the bridge has been cut to the required thickness, the voltage polarity is reversed and metal ions from the jets are electroplated into the pits By using suitable metallic salts for the etching fluid, a rectifier-type contact is made between the deposited metal and the semi-conductor pellet, giving transistor action

▶ **Better Transistors Result**—Despite limited experience with its new process, Philco has achieved the following

• **Higher-frequency operation,** with alpha cut-off frequency consistently higher than 50 mc., occasionally higher than 100 mc

• **Low voltage-power.** New unit operates with collector voltage only one-third to one-fifth as large, and uses only one-tenth to one twenty fifth as much power as point-contact and tetrode transistors with comparable frequency response, Philco reports

AVIATION WEEK inquiries indicate that the transistor industry is impressed with the new Philco technique, particularly its jet-etch approach to transistor fabrication. Here is what they like about the process

• **Easily controlled** The entire process is simple, easily controlled, indicating that the surface-barrier process can easily be adapted to automatic production machinery

• **Precise dimensions.** Process makes it possible to fabricate transistors with a very thin bridge of semi-conductor between collector and emitter This gives device a high frequency response, enables it to operate with low voltage

• **No contamination** The jet streams continuously wash away the molecular sawdust produced during the process and keep pellet surface free of contamination until after the emitter and collector junctions have been formed

• **No structural damage** The etching process operates only on top layer atoms, preventing damage to pellets' all important mono-crystalline structure

▶ **High-Temp Transistors**—More recently Philco has disclosed that it has made experimental surface-barrier transistors of silicon, which can operate at temperatures of 150 300C Philco reports these experimental silicon transistors have amplification factors (alpha) greater than 0 95 (some as high as 0.995), and alpha cut-off frequencies higher than 10 mc

On the heels of this disclosure comes an announcement that Raytheon Mfg Co has developed and is testing silicon transistors The company says that present units have been operated at 175C, but emphasizes that there is much work to be done before it will be in production on silicon transistors

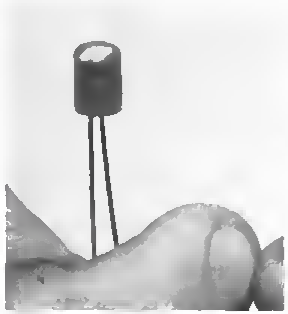
One of the most serious obstacles is lack of quantity production of silicon with required degree of purity Du Pont and others are working on new refining processes for silicon Present price tag on transistor-pure silicon is $430 per pound

▶ **Other Semi-Conductor Developments**—Some of the other noteworthy developments in the field of semi-conductors during the past year include

• **High-power transistors,** Minneapolis-Honeywell recently disclosed that it has developed an experimental power transistor rated at 20 watts General Electric is currently testing an experimental liquid-cooled junction power transistor rated at 100 watts Transistor Products, Inc says it is producing junction transistors rated at two watts out-

put power, in Class B amplifier circuits.

• **Silicon diodes.** Last fall, Bell Labs announced the development of a silicon alloy diode with a back-to-forward resistance ratio approximately 1,000 times higher than for existing germanium diodes, able to operate at 200C temperatures. More recently AVIATION WEEK learned that Hughes Aircraft is now in production on silicon diodes, making it possibly the nation's first mass producer. General Electric is reported to be well advanced in its silicon diode development.



SILICON SEMI-CONDUCTORS, such as this Bell Telephone Labs diode have high-temperature capabilities previous germanium semi-conductors lacked. This will permit airborne avionics uses previously impossible.

• **Transistor photocell.** General Electric recently announced a p-n junction transistor photocell which is extremely sensitive, particularly to infrared radiation, making it attractive for use in missiles designed to seek out heat radiating targets. Output from new experimental photocell is large enough to operate a relay directly, without intermediate amplification, GE says.

▶ **Transistors Too Big**—Although transistors are small, compared to their vacuum tube counterparts, the germanium or silicon pellet which forms the heart of the device is only a tiny portion of the total volume occupied by a present day transistor. The leads, base, supports, and other paraphernalia add up to several times the volume of the transistor element itself.

In coded-pulse voice communication, a large number of extremely selective filters are needed, and transistors make attractive active-element filters.

Digital computers and devices require vast arrays of transistor flip-flops and diodes. For some contemplated airborne equipments, size and weight still would be prohibitive, even if completely transistorized with present size units.

▶ **Microtronic Construction**—That's why AFCRC has set up a microtronics group to study and sponsor the development of radically new processes for creating large arrays of transistors and diodes, and their necessary interconnections. By depositing successive layers of germanium (and impurities) on a small postage stamp size card which has razor-thin interconnecting conductors engraved on it, AFCRC hopes eventually to construct a 1,000-element transistor diode matrix in a volume of 0.5 cu. in.

AFCRC is sponsoring research programs at Battelle and the Mellon Memorial Research Institutes, aimed at new microtronic basic techniques for fabricating or "growing" all types of electronic components and circuits.

Speaking before the Radio Technical Commission for Aeronautics, Dr. W. R. G. Baker, GE's vice president in charge of its electronics division, said:

"It may be possible, in effect, to grow capacitors, resistors, as well as transistors into a single crystal."

It is reasonable to assume that Baker's own division is investigating this possibility and that some report of progress could come within the next year.

By focusing attention on the new field of semi-conductors, the transistor has opened up vast new areas for exploration.

It is not thought inconceivable that a complete semi-conductor amplifier or flip-flop stage could be grown, no larger than present-day transistor pellets. This, if and when it comes, will complete the revolution in electronic construction techniques which is already under way.

Automation

Until recently, electronic equipment fabrication seemed to defy automation. A typical equipment consisted of hundreds of different-sized and -shaped components, laid out in a functional, but hodge-podge manner, with a rat's nest of interconnecting wires.

Among military equipments, electronics had the highest percentage of hand labor, except possibly for some precision instruments. This fact, when viewed in the light of vastly increased military use of electronic gear, sent shivers down the spines of military mobilization planners.

After the war, Britain's Sargrove Electronics Ltd. constructed a machine which could turn out 500,000 two-tube radio chassis a year automatically except for manual installation of the speaker, power transformer and tubes. Needing a production run of 20-100,000 sets to justify its construction and tooling cost, no more machines were built after the vast Asian market disappeared behind the Iron Curtain.

▶ **Printed Circuitry**—In this country, the military services and industry moved more cautiously after the war.

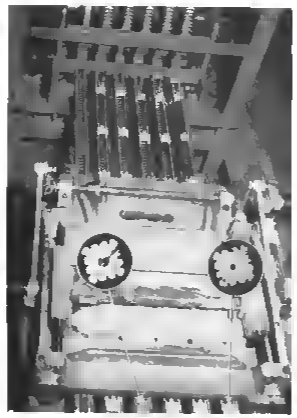
The Signal Corps and others pushed the technique of using printed circuitry and dip-soldering. Most of the interconnecting wires were etched or printed on a fiber board, appropriately located holes were drilled or punched, component leads were inserted by hand in these holes, and the entire assembly dipped in a solder bath to secure and connect the components.

Today this technique is a widely used time-saver in medium or large production runs of both civilian and military equipment.

About two years ago, the Signal Corps contracted with GE to develop a machine which could automatically place conventional components in printed circuit boards, acting under instructions from a magnetic tape or punch card. This program is expected to eliminate the major remaining hand operation. GE is also developing associated machines to test components cut and form their leads, and transport them to the component placement machine. This program, first reported in AVIATION WEEK (Nov. 17, 1952, p. 36), is slated for completion by mid-1955.

Meanwhile the Air Force had launched a study development contract for automation of avionic equipment construction at the Stanford Research Institute.

▶ **Navy Bombshell**—Very little had been heard from the Navy until last fall when the Bureau of Aeronautics dropped a bombshell by announcing



NAVY NBS PILOT PLANT turns out variety of small avionic modules almost completely automatically. This machine silver paints conductor patterns on six ceramic wafers at one time.

that the National Bureau of Standards had developed an automatic factory for producing electronic equipment and it was in pilot plant operation. The code name for the operation was "Project Tinkertoy" (recently given the unwieldy designation of "Modular Design of Electronics" and "Mechanized Production of Electronics")

Within several weeks, more than 1 000 representatives from every electronics equipment and component manufacturer of consequence had journeyed to the 'Tinkertoy' Mecca, just outside of Washington.

Industry learned that instead of trying to automatize conventional electronic components and construction techniques, NBS had developed new components and techniques specially suited to automation (AVIATION WEEK Sept 28, 1953, p. 17, Oct 12, 1953, p. 72).

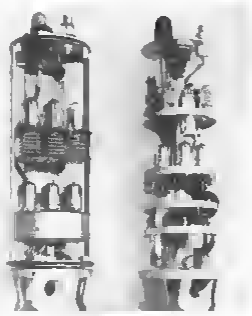
MODULAR-DESIGNED avionic sub-assembly (called MDE) turned out in "Project Tinkertoy" automatic factory is constructed from small ceramic wafers, uses tape resistors, printed capacitors and conductors

► **Ceramic Modules**—Keystone of the process is a small ceramic wafer, seven-eighths of an inch square, which is machine-formed and upon which are printed necessary conductors. Printed capacitors on ceramic bodies, or resistors printed on tape, tube sockets, or inductors are attached to the ceramic wafers, several of which are then stacked and interconnected to form a completed module, all by machine operations.

Except for conveying wafers from one machine to the next, the present pilot plant is almost fully automatic, including testing machines which automatically throw out rejects.

► **Tinkertoy Advantages**—The Navy sees several attractive advantages to its new process:

▪ **Lower cost.** Recent study by a management consultant indicates that Tinkertoy plant can cut cost of building electronic equipment up to 44%, including amortization of the plant over a 10-year period.



COMPARISON of Navy sonobuoy constructed with conventional techniques, right, and new "Project Tinkertoy" MDEs, shows how new process eliminates familiar "rat's nest" of interconnecting wiring

▪ **Versatility.** Tinkertoy plant can be changed over in a matter of several days to produce a variety of modules for different types of equipment. This is particularly attractive for converting a consumer goods plant to military production in an emergency.

• **Easy expansion.** Tinkertoy plant production can be quickly and easily expanded in an emergency by adding shifts, operating seven days a week, without need for training new personnel.

▪ **More uniform quality.** Elimination of manual operations and use of 100% inspection during manufacturing cycle should produce more uniform, better quality product, Navy expects. (One or two of the present pilot plant machines are suffering more than 50% rejects, but are currently being redesigned.)

► **Some Drawbacks**—There are some limitations to the new process. For instance:

• **Expensive for small runs.** Initial tooling and set-up costs of a Tinkertoy mechanized line make it best for high production runs, yet many military items are produced in limited quantities of several hundred or a thousand, with frequent design changes during the run. The Signal Corps-GE machines, which can be converted simply by changing tapes or cards, may be better adapted, more economical for small runs. However, recent cost analysis indicates that Tinkertoy-type module construction, made with hand jigs, can be employed for small runs and offers almost as much economy as a mechanized factory line.

• **Limited capability.** Large size capacitors, high-power resistors, inductors and certain other components cannot be made by Tinkertoy machines, at least so far. NBS is working to expand the range of values which can be obtained, but some observers feel that it will always be necessary to use some conventional components. Mixing manual and automatic operations negates some of the advantages gained by using Tinkertoy.

• **Restricts miniaturization.** Present Tinkertoy module size and weight compares favorably with conventional miniaturized construction, but is larger and heavier than conventional sub-miniature construction. Some observers have the opinion that the adoption of Tinkertoy may limit further size and weight reduction.

► **Industry Interest**—Westinghouse Electric Corp. is reported to be considering setting up a Tinkertoy plant, with the view to using its output both for military and consumer products.

There is reason to believe that American Car & Foundry, which recently set up an electronics division in Alexandria, Va. (near the pilot plant), has similar ideas. The new division is headed by J. G. Reid, Jr., and R. L. Henry, key men in the NBS Tinkertoy project.

The Navy reports inquiries from companies in Canada, Britain, France, Switzerland, The Netherlands, India, and Japan.

These developments, which could upset the traditional balance between component and equipment manufacturers, are being carefully watched. If an equipment maker sets up a Tinkertoy plant, he will spend fewer of his dollars with the components people. If the latter should set up a plant, as several are reportedly considering, it would reduce the equipment manufacturer's share of the pie.

Regardless of the future of the specific modular-type construction and mechanization which Navy-NBS have developed, Project Tinkertoy has sharply jolted industry with the realization that automation of electronics is no longer "around the corner."

► **Advancing the Art**—Electronics, a fast-moving science in its own right, gets a big shot in the arm when it joins hands with the military, and particularly with military aviation.

The continuing search for weapons superiority in a supersonic, hydrogen-bomb age has produced a condition in which military aviation is the biggest single force behind research in electrical technology and manufacturing know-how.

Industry and research laboratories engaged in avionics work are the vanguard of this march. It is in avionics that the frontiers of radar, computer, servo mechanisms, and communications knowledge are advancing most rapidly. From this knowledge will come the civilian and industrial products of the next and succeeding decades.

RADAR TRAFFIC CONTROL, using surveillance radar like this General Electric ASR 2, and war surplus long range military radar, has greatly improved traffic flow around major airports. If means can be found to enable Air Route Traffic Control Centers to use extremely long range military early warning radars, even greater strides can be made.

The Outlook for Civil Avionics

'New' ANDB May Be Key to Progress

Controversy still slows adoption of ultimate civil-military navigation system, but revitalized Board now has increased power and authority to act.

Avionic developments and events in civil aviation during the past year present a mixed scene of progress, controversy and discouragement. The recent reorganization and revitalization of the Air Navigation Development Board gives reason to hope that the controversy will be resolved and that a positive well-aimed program of development will result.

The past year saw:

- Controversy over whether Civil Aeronautics Administration should convert its present civil DME (distance measuring equipment) to a newer military system, called Tacan.
- Accelerated activity in the development of an airline airborne weather radar, spurred by competitive and conflicting views on the best operating frequency for such a device.
- Encouraging results from the use of surveillance radar and peripheral VHF networks to speed air traffic flow.
- Slow progress in solving other traffic control problems.
- Speedy action in adopting a new selective calling system, called Selcal, designed to ease the pilot's radio monitoring duties.
- Reorganization of the Air Navigation Development Board, giving it increased authority and power, to resolve present DME controversy, prevent future problems of this nature, and spur the development of the ultimate common civil-military navigation system.

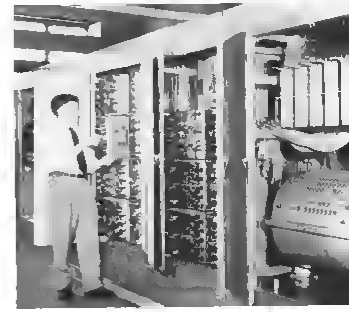
▶ Uneven and Slow—Compared to some of the radical military avionic developments, civil progress seems uneven, slow. In part, this is inherent in the nature of things.

The military gets the lion's share of development funds, with civil getting the table scraps. The military must and does reach out for bold technological advances a risk which the CAA cannot afford. New civil navigation and communication equipments come into widespread use more slowly, and only when airline business, and private fliers can justify them economically.

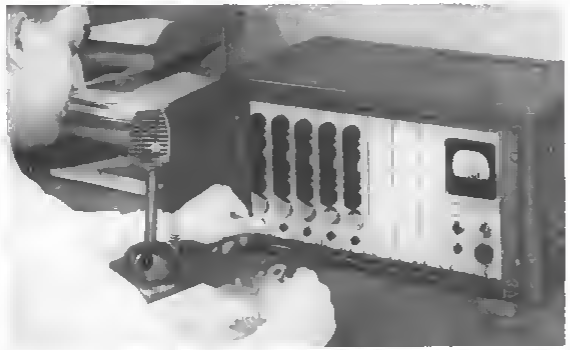
There is another reason. The ANDB program which should have provided many advanced common system developments was badly hurt several years ago.

Disagreement within the ANDB resulted in the withdrawal of effective support by the military, who pulled out many important projects for exclusively military development. With very limited funds, and little authority, ANDB has had to limp along.

CIVIL DME equipment is in production by Narco and Bendix/Hazeltine despite the uncertainty regarding the program.



AUTOMATIC flight plan processor, designed to store up to 2,000 flight plans on a magnetic memory drum, search for possible conflict and provide information on approaching aircraft to Air Route Traffic Control Centers, is under evaluation by CAA.



SELCAL, new selective calling system which enables airline ground stations to buzz individual aircraft when it wants to talk to them, has generated airline interest

▶ **Whither DME?**—The present civil military DME impasse is another direct result of the previous unresolved differences within ANDB, and in its wider implications, the cause of the original breakup. Since that time, the military has proceeded independently with development of its tactical navigation system (Tacan), along the "Ultimate Common System" lines recommended by Special Committee 31 of the Radio Technical Commission for Aeronautics.

Meanwhile, CAA has proceeded with implementation of the "Interim Common System," using VORs and DMEs recommended by RTCA's Special Committee 40. A recent CAA statement indicates that it intends to complete installation of all planned VORs and DMEs this year.

The military plans to use Tacan for aircraft operating in the U. S., and is concerned over possible interference between it and civil DME in some locations. Both are pulse-type systems operating in the 1,000-mc band. The civil system uses 50 mc of the band, with 2½ mc channel spacing, and pulse-coding (multiplexing) to provide 100 individual interrogate and reply channels. Tacan requires 250 mc, with 1 mc channel spacing, reserves pulse-coding for transmitting station bearing and other information.

▶ **The Military Problem**—The military, operating under an economy-minded administration, is confronted with two unpleasant alternatives in addition to the interference problem. These are:

- **Set up a Tacan network** which essentially duplicates existing federal airways and provide necessary operating and maintenance personnel at a cost estimated at $50 million.
- **Equip military aircraft** with both civil and military navigation gear, to enable them to operate in the U. S., yet fly overseas and operate in a tactical area on a moment's notice. This means added equipment costs, and—more important in jam-packed fighters and interceptors—added weight and space requirements.

Thus explains why the military now want CAA to modify its present civil DME ground stations to Tacan system. If this were done, military aircraft would obtain both distance and station bearing signals from CAA Tacan-DMEs, while civil aircraft would get only distance information. Civil aircraft would continue to use present VORs to obtain bearing information.

▶ **CAA Sits Tight**—So far, CAA has refused to budge, pointing out that it has already purchased 450 ground stations, all installed at their sites, one-third of them in operation. CAA, and civil DME supporters, say that a change would:

- **Delay civil DME use** by three to four years, requiring extensive modification of present ground stations, development of new civil airborne units. (Both Narco and Hazeltine/Bendix are now in production on civil airborne DMEs.)
- **Increase cost of airborne units** for civil aircraft because of closer channel spacing and added design sophistication in Tacan, a serious objection for private and business aircraft operators.
- **Abandon proven system** for one which is still far from operational. (AVIATION WEEK inquiries to qualified people produce differing opinions as to whether Tacan is presently "de-bugged," an indication that some problems may still exist.)

▶ **Tacan's Civil Advantage**—Tacan supporters counter these arguments by pointing out that it has potential for growth into the ultimate common system blueprinted several years ago by RTCA's Special Committee 31. By adding small adaptors to a civil Tacan-DME at some later date (when these portions are declassified), a single black box could provide distance, station bearing, transponder (safety) beacon, and possibly even private line ground to air communications, they say.

The opposition acknowledges that some of the techniques used in Tacan may find application in the ultimate common system but says that the future system should not be handcuffed by Tacan's limitations. (For a more detailed presentation of the pros and cons, see AVIATION WEEK Dec. 7, 1953, p. 40.)

One of the first tasks of the reorganized ANDB is to evaluate Tacan for "possible later application in the common system," according to the official Commerce Dept. release. Observers expect the new ANDB to attempt to resolve the present military-civil DME impasse at the same time.

▶ **Brighter Radar Picture**—By contrast with DME, the airline weather radar program looks more encouraging. After more than a year of study, investigation and experimental flight test to establish requirements, development of airline radar for storm warning use is moving ahead full speed. The program is accelerated by technical disagreement over whether the older X-band (3.2 cm.) or newer C-band (5.7 cm.) is best for airline use.

Two manufacturers are currently in the race:

- **Radio Corp. of America** expects to fly a C-band prototype within 14 months, be in production within two years.
- **Bendix Radio** says it will fly a prototype X-band set in a few months, hopes to be in production within a year.

Arinc's Airlines Electronic Engineering Committee recently completed its airliner radar characteristic (spec) which calls for operation in C-band. AEEC's choice is based on the radar's primary intended use in storm avoidance and the accepted fact that C-band energy suffers less attenuation than X-band in heavy rainfall. A limited study by Drs. J. S. Marshall and Walter Hitschfeld, weather-radar experts at McGill University, indicates that C-band has considerably greater range of penetration through heavy rainfall.

United Air Lines has concluded that C-band radar is the optimum for airborne weather mapping purposes, on the strength of its analysis of last summer's tests on an experimental RCA C-band set. However, except for one informal and inconclusive test with a Navy R5D, there was no direct X-band versus C-band comparison.

▶ **Pros and Cons**—Opponents of X-band say that its shortcomings will show up

which an aircraft must traverse. A front containing heavy rainfall. X-band attenuation will give a false picture of storm depth, reduce the effectiveness of iso-echo contouring type radar display intended to show pilot paths of low turbulence, they say.

To this, X-band supporters point out that a C-band radar beam is almost twice as wide as X-band for the same antenna size, will therefore be unable to see narrow non-turbulent paths between storm cores. They also point out that pilots will try to fly completely around storms, wherever possible. Through clear air or light rain X-band is able to spot storms at a greater distance than is the case with C-bands. (For full discussion, see AVIATION WEEK Feb. 22, p. 52.)

▶**Other Factors**—X-band radar is generally given a small edge from the standpoint of weight and size because C-band waveguides and magnetron are necessarily larger. X-band probably will have a price edge because RCA must develop a new C-band magnetron, although the company hopes to liquidate development costs over a long period and several other possible applications.

However, C-band supporters say the new magnetron will be conservatively designed to airline reliability needs, an advantage over an X-band tube developed for military use, where every ounce of performance is squeezed out.

▶**Airline Interest**—Among the larger aircarriers, there appears to be considerable interest in weather radar. Panagra is installing a military AN/ASP-42 (X-band) set in a DC-6B expects to be the first to try radar in regular operations, may be the first to equip its fleet probably with Bendix radar. United is close behind, might soon order for its DC-7s. PanAm is planning to test the Bendix prototype (X-band) set this summer. Braniff currently has two APS-42s on loan from the Navy, is scheduled to install one this month. TWA and National are also interested.

An Arinc survey of airlines last spring indicated that practically all of the operators either wanted radar installed, or provisions for installation in their future four-engine aircraft. However, only half of the future twin-engine aircraft were wanted with radar or installation provisions.

▶**Speedy Action**—There is recent evidence that airlines and the avionic industry can move fast to make use of a new technological development for an operational need. The evidence is a new selective calling system called "Selcal." Selcal permits an airline ground radio station to flash a light or ring a buzzer in the cockpit of an individual plane to which it wants to talk, and relieves the pilot of continuously monitoring his radio receiver for possible incoming calls (AVIATION WEEK Nov. 16, 1953, p. 71).

Pan American World Airways' Pacific Alaska division recognized the problem, adapted an industrial calling system (developed by Motorola) for airborne use and tried it out. Selcal proved so successful, that PAA decided other airlines might be interested. Operating through Arinc's AEEC, an industry-wide system characteristic was prepared.

Two manufacturers, Motorola and Bendix Radio, quickly designed airborne and ground equipments for airline use. Motorola is already in pilot production, Bendix expects to follow shortly.

In addition to finding application in overwater carriers, Selcal may also be useful in domestic operations where pilots are spending more time monitoring Air Route Traffic Control Center VHF channels, making it more difficult for their company radio operators to raise them on their own UHF channels.

▶**Fewer Delays**—Air traffic now flows faster, with fewer delays in IFR (instrument) weather, makes more frequent landings and departures at and near high density airports. This is the result of increasing use of surveillance radar and direct communications between Air Route Traffic Control centers and the aircraft operating under their supervision.

▶**At Washington National**—Radar traffic control, pioneered at Chicago Municipal Airport and CAA's Technical Development Evaluation Center in Indianapolis, has been most fully implemented at Washington National Airport (AVIATION WEEK Mar. 16, 1953, p. 14). A war-surplus military radar gives the Washington ARTC center vision of all aircraft up to 100 miles away, extending the normal 30-mi. range of the control tower ASR-1.

With radar sight, ARTC can funnel inbound, and reverse funnel outbound, traffic with aircraft separation reduced from 15 to only five miles. Inbound traffic is fed to four main approach gates (fan marker, or compass locators) where control tower operators, using their ASR-1, take over.

▶**Before & After**—During the first year of full radar control, Washington was able to:

- Double airport capacity during IFR weather.
- Cut traffic delays. Total delay time during three-month winter period was cut almost 9:1 over corresponding interval in previous year.
- Virtually eliminate stacking.

With increased operational knowhow gained from experience, there has been further improvement this winter over last. A comparison of total ap-

proach delays shows
- December 1952, 4 hr 15 min 1953, 1 hr 10 min
- January 1953, 28 hr 47 min, 1954, 2hr 10 min

▶ **Expanding Radar Use**—Surveillance radar is now used for IFR arrival and/or departure control by towers at all three New York airports, at Chicago, and at Los Angeles. It will eventually be used at 52 major airports slated to get ASRs.

There are still problems, however. Exercising arrival and departure control in high-density traffic normally requires two radar operators, but at present both must crowd around a single PPI scope. Lack of bright tube radar displays still forces radar operators to sit under "tents" during daylight hours, another inconvenience. Limited CAA funds are generally blamed for slowness in developing and providing these improved facilities.

ARTC centers are still operating without long range surveillance radar, except at Washington. There is much talk of using military early warning (MEW) radars now located near ARTC centers. Principal problem is to get necessary money to set up microwave relays or other means of piping air defense radar presentations into ARTC centers. Funds may become available this year to provide such facilities to a few major ARTC centers.

▶ **Direct Communication**—To take full advantage of its radar vision, ARTC needs, and is getting, facilities to permit direct communication with en route aircraft. Previously, ARTC controllers had to relay instructions through individual airline radio operators. Sometimes it would take five minutes from the time an ARTC controller issued instructions for an airplane to descend to a new altitude before he received assurance that the airspace was available for assignment to another aircraft. This resulted in poor airspace utilization.

By giving ARTC centers a single VHF channel, and later expanding the number of channels, part of the bottleneck was broken. However, VHF's line-of-sight range limitation (75-100 miles) has led to a new scheme, called peripheral communications, i.e., remotely located VHF stations tied in by telephone line to an ARTC center.

The idea was first tried at the New York center, with stations located at West Chester and Scranton, Pa. (AVIATION WEEK Jan 26, p 38). These two stations effectively doubled the range at which controllers could contact aircraft.

▶ **Remote VHF Payoff**—The New York center's traffic capacity has been increased 18.25%, largely as a result of its peripheral communications, a CAA spokesman estimates. For instance, three aircraft can now be laddered down in altitude in four minutes instead of nine. Its success has resulted in plans for similar facilities at other major centers, including Washington, Chicago, Boston, Pittsburgh, Indianapolis, and Cleveland (which already has one remote station at Buffalo). Date of implementation will depend upon how far CAA can spread its funds.

Installation of UHF equipment, for use with military aircraft, has been slow at ARTC centers. (It is also slated for use at remote sites.) Reason is reportedly a shortage of ground-station equipment because of disagreement over whether CAA or the military should finance installation.

▶ **Less Encouraging Progress**—"If it were not that the present flight-progress strip system (for keeping track of aircraft under ARTC control) were actually in existence, it would be difficult to convince any reasonable person that such a system could be made to work at all," S. P. Saint recently told the annual meeting of the Institute of the Aeronautical Sciences in New York. Saint is director of ATA's Air Navigation and Traffic Control Division.

Despite many studies of the problem, ARTC controllers are still using essentially the same manual posting technique they have always used, with

vastly increased traffic density. During the past year, ARTC controllers filled out an estimated 15 million flight progress strips in longhand, noting pertinent identifying information on the individual flight and its estimated time of arrival over the next position fix. As aircraft give revised ETAs, or are given new altitude assignments, the controller must cross out the old figures and write in the new ones.

The progress strip is normally placed before the controller 40-60 minutes before the flight is due over the fix, is retained until 10 minutes after the flight passes. For 300-mph airliners, four to seven of these strips must be prepared for 30 minutes of flight, a jet will use them up even faster. Strips are racked up in front of the controller in order of their ETAs, without any attempt to give a graphic display of aircraft altitude or relative position.

▶ **Progress Strip Limits Progress**—As a result, Saint points out, "The controller must discover a conflict or (an opening for) additional clearance . . . by conscientious and continuous examination of this large volume of handwritten data (which is) not capable of automatic transmission or display. There is no way to interlock or coordinate automatically at the many boundries of control jurisdiction,' Saint points out. "This . . . will drastically curtail the efficient use of radar (in ARTC centers) . . . (and) efficiency drops sharply when an unexpected irregularity occurs."

▶ **Pity the Controller**—Stanley Seltzer, former chief controller at Washington National Airport, now a member of ATA's ANATC division had this to say in speaking before the IAS:

"To force the manual system to absorb the increased traffic load (there has been) division among greater numbers of controllers (with each) given a smaller and smaller area to control. However, this has only added to the problem by increasing the amount of coordination necessary between controllers . . . (which) involves a majority of (their) time," Seltzer says.

▶ **Many Studies, No Cure**—At the IAS meeting, Saint pointed to an 18-inch-high stack of previous study reports on various types of visual traffic display systems to replace the much-criticized flight progress strips, then proposed his own ideas for a new system, the result of an ATA study.

The system resembles the "block system" of control used by the railroads. Aircraft positions in the controlled blocks are indicated by small "tokens," which controllers plug into their individual consoles. An electrical interlock system, operated by the tokens, flashes lights to show when aircraft may be cleared to next block or assigned to new altitude. Position of tokens gives graphic portrayal of airplanes' relative positions.

By the time Saint had developed his system from its simple fundamentals to accommodate traffic intersections, it was apparent that the complexity of three dimensional aircraft traffic flow precludes any simple solution and may explain why ARTC is still using the old flight progress strips. Saint expects to submit the idea to the Air Coordinating Committee for further study and analysis, to focus attention on the problem.

▶ **Not Oblivious**—ANDB and CAA have not been oblivious to the need for automatic data handling equipment to post and transfer aircraft flight plans. They are currently starting to evaluate a magnetic memory digital system at TDEC in Indianapolis. Developed by Engineering Research Associates division of Remington Rand, the machine is essentially a large digital computer designed to perform two important functions:

- **Flight plan processing.** Some 2,000 flight plans can be electromagnetically filed, stored, and quickly scanned (0.4 sec.) for possible conflict. As envisioned, the device could automatically transmit flight plans to ARTC controllers along aircraft's route as needed.
- **Weather data processing.** Device can also store up-to-date weather observa-

tions and forecasts from many remote stations, for immediate access by any station in the network.

Present thinking is that teletypes will be used to feed flight plan or weather data to the machine, special display boards or teleprinters will be used to obtain information from it. The application of the machine involves both operational and technical problems which TDEC must work out.

▶ **Indianapolis Center**—New traffic control aids and procedures will get their evaluation in an actual operational environment after this summer, when the Cincinnati ARTC center moves to the Indianapolis Weir-Cook Airport to become part of the new Airways Operations Evaluation Center (AOEC) being established.

AOEC will explore the wider use of radar traffic control, using PAR, ASR, long-range S-band and L-band radars and eventually airport surface detection equipment (ASDE), a very-high-frequency radar for airport surveillance.

AOEC plans to explore several techniques for operating remote enroute radars, piping their pictures into an ARTC center. Techniques will include microwave relay, broadband cable circuit, slowed-down video to permit use of narrow-band telephone lines.

AOEC also intends to evaluate several techniques for identifying individual aircraft on radar scopes, including use of radar (safety) beacons, ground direction finders, position fixes that are established by means of airborne VOR-DME.

▶ **Human Engineered Centers**—Another important objective of the AOEC program is a more efficient ARTC center design, including better communication and handling procedures, with adequate attention to principles of human engineering. Bell Telephone Laboratories are under contract to develop improved interphone systems, air-to-ground communication consoles, floor plan layouts and acoustics.

To evaluate suggested improvements and new techniques, AOEC will have dual ARTC facilities within a single room. On one side will be the regular operational center, always ready to perform required duties. The other side will be an experimental center in which new ideas are incorporated. When these are ready for evaluation, one or more of the ARTC controllers will shift their chairs to the other side of the room.

If new devices prove unsatisfactory, the controller can instantly return to the regular center. If they prove desirable, the improvements will be incorporated in the regular center.

▶ **Progress Slow**—Despite ambitious plans, progress is spotty. For instance,

airport surface radar (ASDE) was an early postwar development, and a modified version was tested for several months in 1952-53 at N. Y. International Airport. Yet an improved equipment (less affected by rainfall) now under design will not be available to AOEC until 1956-58, an ANDB spokesman estimates.

The important airborne radar beacon development program, intended to provide positive means of identifying aircraft on ground radar scopes, has suffered many delays and false starts. Last summer the program was re launched on the basis of L-band (1,000 mc.) operation with interrogation by special (secondary) ground radars. But the program is once again up in the air because the military has indicated that a new choice of frequency may be necessary.

There are many explanations for the slow pace, but an important one is the lack of a strong ANDB program with full civil and military support and adequate funds. For several years, military avionic development funds have run almost 100 times those of the CAA ANDB. In the post-Korean period, when demand far outstripped avionic industry facilities and manpower, the military has had top priority, if only by virtue of its funds.

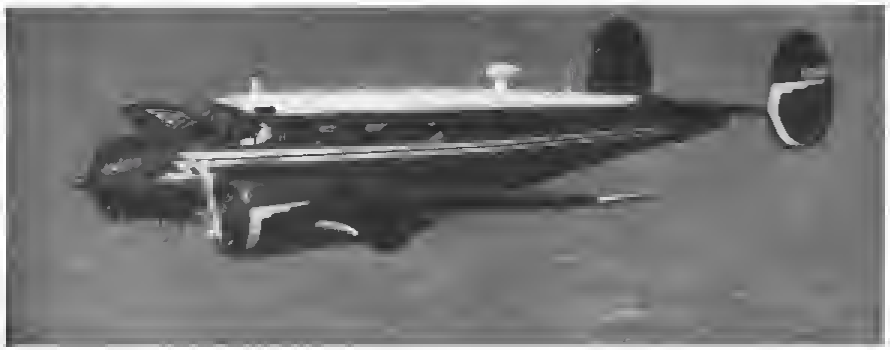
▶**Eyes on ANDB**—The aviation industry has its eyes focused on the newly reorganized ANDB to see whether its new top-level members can resolve problems which splintered the previous group. Their first task is to resolve the civil DME versus Tacan hassle, about as tough a problem as they could have found.

ANDB's success in solving this and other difficult problems, and in laying out a long-range "Ultimate System" development program during the coming months will determine whether we have a navigation system which meets the needs of the next decade, and whether it is a "common" civil-military system in name only or in reality.

▶**Military Dividend**—Many of the military avionic developments now under security wraps will in time be declassified for civil use. At least much of the technical know how will find civil application. Tacan and digital communications are two examples.

Civil aviation will benefit from microtronic construction techniques which will permit major size and weight reductions for growing numbers of avionic equipments which have been encroaching on airliner payload. In lightplanes this sub sub miniature construction will permit better all-weather instrumentation without seriously compromising payload.

These are some of the worthwhile by-product returns which civil aviation can expect from tax dollars which go into military avionics development.



BEECH D18S

Business Flying

Multi-Million Market Goes Begging for Takers

Business flying, still riding the crest of its phenomenal postwar boom, is expected to gain even wider acceptance during 1954 as more companies take to the air in their own planes.

Lifting of the excess-profits tax in January was interpreted in some pessimistic quarters as the turning point which would see companies taking inventory of the high cost of operating aircraft with a view to eliminating this "luxury" item from their budgets.

▶ **Here to Stay**—But the trend seems to be exactly the reverse, as more U. S. business firms accept the premise that convenience and time saved in flying high-priced executives more than compensate the cost of aircraft operation.

Stockholders, heretofore the most inclined to rebel over airplane expenditures, seem to be taking a more liberal view and are becoming increasingly air-minded in their thinking.

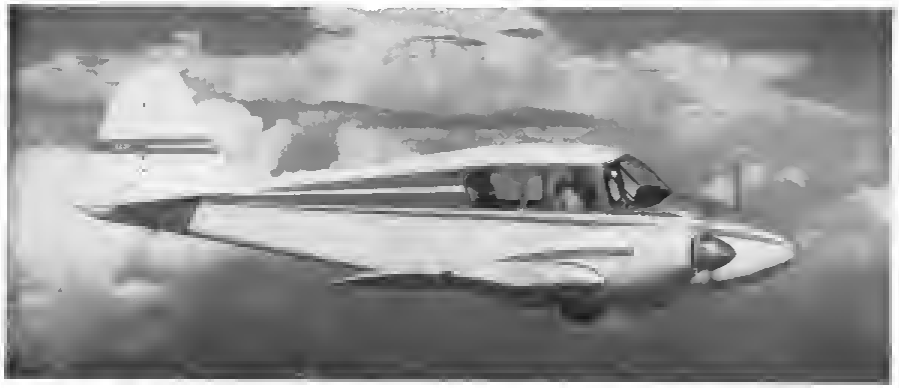
From all of the present indications, it would appear that business flying is here to stay.

▶ **Growing Pains**—Certain basic problems must be solved, however. Business flying is currently going through a series of "growing pains" that must be treated skillfully if the field is ever to realize its full potential as an integral part of U. S. industry.

Right now, it's going through what might be called the "awkward" stage, having reached the maturity of a full-grown segment of aviation but still waiting for organizational and technical advances to catch up with it.

▶ **Major Problems**—Some of the chief problems:

• **Lack of adequate equipment.** Present owners for the most part are not satisfied with their aircraft. Either they are using obsolete transport models, converted World War II bombers, or, as a compromise, they are operating later models that are not particularly suited for their purposes.



PIPER APACHE

CESSNA 310

These planes may be outstanding designs in their own right, but the majority of flying executives holds either capacity or performance-wise they do not meet all of the requirements for a business aircraft.

• **Lack of basic information.** Companies operating business planes, and those contemplating such operation, are in desperate need of a common medium whereby they can obtain basic information on the field and also exchange ideas on operating procedures to mutual advantage.

• **Lack of market data.** Manufacturers, desirous of producing equipment for the business flying market, find that there is an acute lack of information upon which to base specifications for such equipment.

A plane designed specifically for company use, for example, is the dream of most business flying enthusiasts. Operators want such a plane badly, and manufacturers would very much like to produce it.

But in the absence of a common medium through which companies can get together, define what they want in the way of specifications and present unified proposals to the manufacturers, a complete stalemate exists.

Before manufacturers will go into production of a plane specifically designed for business use, they must know exactly what the operators want and they must have an estimate of the size of both the actual and potential markets. Also, they want something in the way of a cash guarantee to help finance production costs.

▶ **Charting a Course**—Some feel that in the absence of a unified proposal by the operators the only recourse may be initiation of an intensive market research program by the manufacturers themselves.

Two things seem certain.

• Until definite specifications are arrived at, the multi-engine business fleet will continue to be made up of obsolescent and 'compromise' aircraft.

• In order to ascertain both specifications and size of the market, mutual cooperation is needed between operators and manufacturers.

Until such a close working operator-manufacturer relationship is brought into being, it is considered doubtful that any type or types of multi-engine aircraft specifically designed for business flying requirements will ever get beyond the drawing boards.

It would be a shame, observers feel, if this new and vitally important segment of aviation were allowed to deteriorate before it has a chance to reach its full potential.

But indications are that this could happen if something isn't done soon toward design and production of specific equipment.

▶ **Can They Compete?**—Companies will probably settle for whatever is available for the next two or three years, but by that time the business fleet, made up of compromise planes, will be in no position to compete with the ever-increas-

AERO COMMANDER

TEMCO TWIN-NAVION

ing speed and efficiency offered by commercial airlines if it cannot offer comparable or even better service.

It would be unrealistic to assume that one plane specifically designed for business flying would satisfy the requirements of all U. S. firms operating aircraft, observers feel. But it would be a step in the right direction. If the specifications are sound, it should satisfy the mass market.

Some smaller companies, of course, cannot afford and do not need the type airplane that most of the larger corporations require. For example, a plane capable of 1,000-mi. range, 300-mph. cruising speed and capacity for 10-12 passengers would perhaps be suitable for larger organizations, but smaller companies can do with the lesser performance and capacity of models presently on the market.

► **Tempting Market**—The fact remains, however, that there is an estimated multi-million dollar market among larger corporations for an efficient, high-performance multi-engine business plane—a plane currently not in existence. This is the market that must be satisfied if business flying is to continue on a large scale.

The desire of corporations for such an aircraft should not be construed as criticism of all of the planes that make up the present business fleet. Each is considered capable in the job it was designed to do, but none has the overall characteristics required for a business plane.

Collectively, they come close to meeting all of the requirements, but individually most fall far short of the mark. Some operators are satisfied, for the present, but the more progressive companies are considering the outlook for the future—three to five years from now.

What they want is a 1956 or 1958 design that will be capable of equaling or bettering the airline service of that day.

So far, nothing is in sight.

► **Impressive Record**—In the meantime, companies operating business planes continue to compile an impressive record with the equipment at hand.

Newest twin-engine models in today's business fleet include:

- **Beechcraft Super 18,** modified, "souped up" version of the Model 18.
- **Aero Commander,** manufactured by Aero Design & Engineering Co.
- **Beech Twin-Bonanza,** Model B50.
- **Apache,** Model PA 23, manufactured by Piper Aircraft Corp.
- **Cessna 310,** manufactured by Cessna Aircraft Corp.
- **Learstar,** a stripped-down, souped-up modified version of the Lockheed Lodestar 18, converted by Lear, Inc. This 10-passenger plane is reported to have improved overall Lodestar performance, cruising at 270 mph. at 10,000 ft. Some feel that this might be the interim answer for a business plane.
- **Temco Twin-Navion,** twin-engine conversion of the single-engine Navion.

Powerplants, size of accommodations and amount of instrumentation vary

BEECH 50 TWIN BONANZA

considerably among these airplanes. For example, the Beech Super 18 is powered with two Pratt & Whitney Aircraft R985-AN-14Bs that deliver 450 takeoff hp. at 2,300 rpm.

The Twin-Bonanza and Aero-Commander are both powered with 260-hp geared Lycoming engines, the Cessna has two Continentals rated at 225 hp., and the Piper has two 150 hp. Lycomings.

Detailed specifications and performance data are given in the specification section of this issue.

►**Old Stand-Bys**—Despite the availability of these newer aircraft, the major portion of the twin-engine business fleet still is made up of the old stand bys:

- **Douglas DC-3.**
- **Beechcraft 18.**
- **Lockheed Lodestar 18.**

Remainder of the group is made up largely of converted World-War-II bombers, such as the Douglas A-26 and B-23, Martin B-26 and North American B-25J. Crumman's Widgeon and Mallard, and Lockheed's PV-1 Ventura round out the twin engine picture, with the exception of a few Convair 240s and 340s used by some of the larger corporations.

►**Single-Engine Aircraft**—The single-engine plane has found widespread application in business flying among smaller companies and individual businessmen who fly themselves. Economy of operation is the big feature.

And there's no shortage of suitable models, either. Unlike the twin-engine owner, single-engine users have a wide variety of modern types from which to choose.

Leaders in this field are the new four-place Beech Bonanza E35, the Piper Pacer and Tri-Pacer, and the Cessna 170 and 190/195 series. Orders are heavy for all of these planes, indicating a high degree of satisfaction with present single-engine equipment.

►**Facts and Figures**—Because of the scarcity of reliable statistics on business flying, it is difficult to obtain a composite picture of the field as a whole—i.e. total number of aircraft currently in operation, percentage of twin- and single-engine planes, number of hours logged, total number of hours flown, etc.

Almost all data currently being circulated is put out by the Civil Aeronautics Administration, and, by CAA's own admission, it is far from accurate.

But, in the absence of facts and figures from other sources, it is all the industry has to go on. Every year, CAA compiles a set of statistics on business flying for the previous year. Such information could be invaluable to operators, manufacturers and all other interested parties, but it has these drawbacks:

- It is published anywhere from 12 to 14 months after close of the year for which data has been compiled (1952 report came out in February 1954).
- It is compiled in such a way as to leave more than a reasonable margin for error and inaccuracy.

►**CAA's Yardsticks**—A typical CAA study lists "inactive" as well as active business aircraft. In many cases, these inactive planes have not flown in several years, but because they are still listed in CAA records as business aircraft they are included in the overall total. In the published figures, however, no differentiation is made between inactive and active planes. As a result, the totals can be off by a wide percentage.

Questionnaires are sent to owners in March or April of the year being surveyed, requesting an estimate of the number of hours that will be devoted to business flying during the year. CAA publishes the total of these estimates as the actual "number of hours flown" for that year.

Many planes are used for combination business and pleasure. In its published reports, CAA lists total number of hours flown by these planes under business flying. This same total is repeated in the section for pleasure flying. No division is made or estimated between the two.

All of these figures receive wide distribution. In the absence of more accurate data, they are relied upon by all operators, potential operators and manufacturers for planning purposes. They constitute the only yardstick currently in existence by which the growth of business flying can be measured.

Possibly CAA may streamline its methods in the future. But, for the present, officials say economy and lack of adequate personnel and facilities prevent a more comprehensive study of the situation.

►**Figures for 1952**—Latest CAA study was released last month for business flying in 1952. Here are the figures:

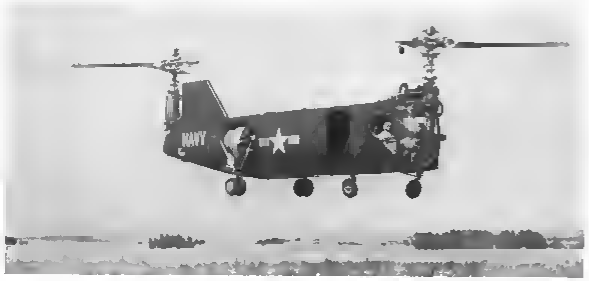
- Hours flown were 3,124,000, almost three times the flight hours recorded for 1946.
- Miles flown increased 11% over 1951.
- "In 1952, general aviation business flying exceeded the revenue hours of the scheduled domestic carriers by some 600,000 hr."
- Total of 30,500 aircraft was engaged in business flying during 1952 (not all exclusively business aircraft).
- Some 11,100 company-owned aircraft engaged in business flying in 1952.
- Individually owned aircraft engaged in business flying numbered 19,400.

Greatest utilization of business aircraft was registered by the petroleum industry, says CAA, with manufacturing and mining industries running close behind. —FS

Military Copter Success Spurs Civil Use

By Irving Stone

Today's copter is far from perfect, but it surely is in business. It is still the product of a relatively young art, but the industry and the public today are more conscious of rotary-wing craft than ever before.



BELL XHSL-1

SIKORSKY XHR2S-1

PIASECKI YH-16

Service experience has demonstrated unmistakably what the craft can do. And the coming era of the copter may usher in a greater collaboration between military and civil users than ever before experienced in aeronautical circles. This can bring far-reaching benefits to the industry in general by cutting down the problems involved in the transition of a military design to civil application.

Anticipating a burgeoning transport era, airline interest is quickening—transportation executives already are in discussion with the major producers of helicopters. This doesn't mean that the present types of copters won't be with us for a long time. They will, but interest is centered not only on existing types but on those in the far-ahead planning stages as well.

Interest in the machine itself isn't the only facet which has been accelerated. Heliport planning also is underway, with ideas being contributed by municipalities, operators and manufacturers alike.

▶**"Different Beast"**—Too frequently the rotary-wing craft is compared with its fixed-wing counterpart—on the basis of cost, speed, range, and cargo- and passenger-carrying capacities—yet often it isn't realized that the copter is a "different kind of beast."

It has unique characteristics and must be justified on this ground alone. Whether you look at it from the viewpoint of cost or performance, there's a price to pay for the ability to hang in the air, go up or down or forward or backward at will—things the conventional plane can't do.

Big operational dividends over and above the copter's basic characteristics will come as engineering refines the machine. Meanwhile, it is going to take a lot of effort to build into the copter a performance comparable to that of the fixed wing—if this ever can be achieved.

▶**Korea's Value**—Military experience, highlighted particularly by Korean theatre operations, although conducted with copters not exactly embodying what was wanted, has gone far to define the usefulness of the copter, pointing the way to abilities it is expected to have.

International emergencies confronting the military have made available readily the development and production money to bring out copters embodying accelerated progress.

Civil operations, particularly those of the local pioneering airways, even now are showing the way to future copter potentials—and requirements.

Where We Stand

At the present reading, it looks as if copter development will parallel, in general aspects, the development history of fixed-wing aircraft.

With the copter's definitely different flying characteristics firmly established and its usefulness emphatically demonstrated, next big factor concerning the designers will be what form the future transport rotary wing aircraft will take—what will be the "optimized" copter, what sort of best "standard?"

▶**Growing Up**—In this respect, development still has not reached a status comparable to the early fixed-wing transport such as the Douglas DC-3. A glance at a yearbook for aircraft of the late 1920s discloses the various configurations of the fixed-wing planes of that era. This, approximately, is the comparative stage in which the copter now finds itself configuration-wise.

Despite the pronounced variations in present-day rotor systems and other rotary-wing details, indications are that the copter definitely is on the path to an optimum configuration. But know-how for this optimization process apparently still is not sufficient. How soon this degree of information will be achieved depends, in the main, upon the effort expended. Pressure for this effort may well be stepped up by increasing airline interest and studies aimed at copters for various route jobs.

It is likely that, in the not too far future, the industry will see the better designs survive, followed by research and redesign leading to at least two copter configurations generally accepted as standard for large-scale transport use. The reason two types will have to emerge is that there will be two general categories of service—a metropolitan or

KAMAN HOK-1

DOMAN YH-31

intra-city run and the longer-hop inter-city service

▶**Good Base**—The move forward for copter development has an excellent base from which to work. Structures are good, rotor head problems in a large measure have been solved, and the all-metal blade, with its excellent characteristics for thermal anti-icing as an aid to all weather operations, has carved a place for itself.

More powerplant types from which to draw are coming into the picture. While the turbine appears as a promising contender, it will have to be researched and tailored for its specific job.

▶**Small Staffs**—Many of the progress factors already chalked up for the copter probably would have been better if rotary-wing companies had engineering staffs comparable to those found among the large fixed-wing airframe manufacturers. One of the latter might easily siphon off 20 or more men for some miscellaneous job, but the loss of this number, even on a short-term basis, would make a serious dent in the creative output of a relatively small rotary-wing builder.

Some comparatively big problems remain. Some of the more pressing ones which must be researched in copter development involve stability, high-speed rotors, vibration, fatigue, and gearing and bearing considerations.

The prospective civil users of copters have had their initial thinking fired by realization of what the helicopter can offer in numerous fields of use.

In addition to the firmly established utility category, the immediate future expansion now seems to have boiled down to the transport and executive-type categories. None of the industry members now building copters consider that the copter will be the average man's aircraft in the near future.

Executive Copters

The executive-type copter is expected to create its own market, opening a broad new field. In many instances, fixed-wing executive craft do not offer much convenience over scheduled air transport, whereas the copter will be able to carry the executive from plant-to-plant sites in industrial areas.

Initially, because of cost and maintenance factors, it is likely that executive-type copters will find application with the big companies, first used by those which already utilize fixed-wing craft.

▶**Utility, Too**—The executive type also will double in the utility category, and ranging from three to eight places will fill a category now in greatest demand in the export market. As an example of the magnitude of the export market, 46% of Bell's Model 47 copter commercial sales finds its way into this outlet.

In the domestic market, uses for the executive utility copter loom big. Even now, 54% of Bell's total domestic sales (U. S., Canada and Alaska) are split into these specialized operations—construction (14%), training (10%), air-mail (8%), local government (6%), ranching (4%), petroleum (22%), utilities (19%), national governments, exclusive of military (10%), overlapping functions (4%), and executive transport (7%). Industry observers see a big expansion in the latter category.

In the production of the small type copter, as opposed to the transport type, Kaman and Cessna probably will emerge as first-line contenders, in addition to those already established in the field.

▶**Cessna Contender**—Cessna, now flying a four-place rotary-wing craft preparatory to certification stages, will go into production this year if present plans go through.

This four-placer is aimed directly at the executive and military market—the company has no intention of getting into the transport field. This is considered a smart attitude, for the company is simply adding another product to its existing line. Cessna is one of the companies in the enviable position of having its fixed-wing sales setups already established. Marketing the copter should be no additional burden.

JACOBS 104

Tronsport Copters

Building copters for the transport category, Sikorsky, Piasecki and Bell are going to be the big factors, although some of the major manufacturers of fixed-wing aircraft are interested in the market prospects. Douglas, for one, has had the intercity copter under consideration for a considerable time and has a design team organized for specific work. Fairchild, too, is said to have a keen interest in the field.

HILLER YHJ-1

▶**Sikorsky**—Sikorsky's 10 place S-55, although performing yeoman service for New York Airways, Los Angeles Airways, and Sabena in Belgium, in what are pioneering copter transport efforts, is considered too small for transport operations now envisioned.

Sikorsky's S 56, civil version of the HR2S—the latest copter to make its debut for military (Marine Corps) work—is scheduled for commercial availability in about two years, subject to Marine Corps approval. This is sooner than was anticipated. It will be offered as a 30-place copter, although it would accommodate 35 for short hops. It constitutes an excellent base for future development in the copter transport field. Its speed, first reported at about 150 mph cruise and about 175 mph top, is now said to be about 25 mph more for each condition.

The next copter to be offered by Sikorsky will be a 50-place job, initially developed for the military, later slated for civil use.

▶**Piasecki**—Piasecki's H-21B could accommodate about 20 passengers. It has been in volume production for a considerable period for the military. Powered by a single engine, cruising speed of the craft is in the neighborhood of 100 mph.

Another Piasecki contender for the near future is its giant H-16 Transporter. Two versions of the craft are in the works—one with two P&WA R2180 piston engines, another with two Allison T38 turbines. A relatively speedy copter, the Transporter will accommodate 48 to 72 passengers, although it more likely will emerge along

the lower band of this capacity range.

Piasecki's craft are tandem-rotor configurations, as opposed to Sikorsky's commitment to single-rotor jobs. Opinion is divided as to which arrangement is better. The single rotor is lighter than a dual or tandem arrangement, involves less complication. On the other hand, the tandem allows greater center-of-gravity flexibility—an important load-placement feature for both military and commercial operations. The CG travel on Piasecki's YH-16 exceeds that in any other aircraft.

▶**Bell**—Bell Aircraft also favors the tandem configuration for large machines. It now has both single and tandem arrangements in production.

Bell's present prospect for the transport field would be a civil version of its XHSL-1 Navy copter. The commercial craft would accommodate about 16 passengers. Powered by a P&WA R2800 engine, the configuration embodies twin rotors with two blades each. This craft is another prospect for commercial availability in 1956.

▶**Compound Copters**—The compound helicopter—a combination of the conventional copter plus additional engine-propeller units carried on stub wings—also is in the picture for future intercity transports.

The Gydrodyne Co. of America has a copter of this type in the design stage. It embodies counter-rotating coaxial rotors, plus stub wing-carried powerplants driving counter-rotating props.

▶**All-Weather Operation**—Looming as a large factor in the copter transport scheme is the need for full realization of all-weather operation with rotary-wing aircraft.

Airlines probably would take delivery of copters prior to perfection of all-weather characteristics, but the prospects are that, in view of the strides being made in that direction, the problem may be fully solved when the planned commercial copters are ready for the market.

▶**How About Noise?**—A vital consideration affecting transport copter operation is the external noise problem. Soundproofing will take care of internal noise.

Where the copter is used in remote operations, noise has been no major factor. As it comes into the metropolitan areas, the copter noise problem poses difficulty. Even now, with an S-55 transport, New York Airways' flight path between Idlewild and Newark airport stretches 29 mi., because of noise and safety reasons, instead of the 21-mi. direct line route.

With the copter about 90% of the total noise comes from the engine exhaust, it is estimated. Muffling this noise appears as a solution, but effect of muffling may make it necessary to go up in horsepower and also bring in additional weight. Gas turbine engines in copters will lessen the noise.

▶**Waterway Routes**—In any event, the copter's superior maneuverability and slow-speed and low-altitude capabilities will make it possible to follow a winding approach path where noise may not prove too much of a disturbing factor. These paths might be highway trunks, railroad lines and waterways.

A large percentage of big cities are on waterways, and these frequently run close to the heart of the city. Thus, waterways not only offer a means of approach but also suggest themselves as advantageous sites for heliports.

▶**Heliport Planning**—Even though heliport questions are far from being resolved, there is a distinct consciousness that it is only a matter of a short time before "city-center" copter takeoff and letdown sites will have to draw close attention. Airport planners already are preparing to meet the condition.

As an example, the budget for a new large airport already is being reexamined because of the expected effect of short-haul and 200-300 mi. copter traffic

SIKORSKY H-19

being diverted to 'downtown' facilities. The budget was projected to take care of the city's airport needs until 1970. Now planners believe that by 1960, about 40% of the traffic will be copter travel. For this reason, a substantial portion is being planned for allocation to a heliport site.

Transport Speeds

General requirements have not yet jelled for copters to emerge within the next few years. Discussions have been on a preliminary basis and have covered the subject in broad terms—from speed and range ideas down to such details as seats and windows.

▶ Speed—Speed capability of about 130 mph. for the metropolitan (intracity) operation copter and a 150-200-mph. figure for the intercity type have been mentioned as feasible. A compound-type copter transport might boost the speed value to 250 mph. or more.

However, specific high speeds aren't seen as too vital a factor because the copter won't have much trouble better-ing city center-to-city center times as sociated with fixed wing planes for the same route.

▶ Capacity—Opinions variously indicate that not less than 30 or 35 passengers would have to be accommodated in the intercity type, with higher limit estimates ranging from 40 to 50.

For the metropolitan service type, estimates indicate 14- to 20-seat types.

▶ Range—Fuel ranges of 200-250 mi. for full gross are seen necessary by some in airline circles. There is opinion that the 200-mi. figure is too high, while others boost the upper figure to 300 mi. with a maximum payload plus sufficient fuel reserve.

Metropolitan operators would consider these general estimates too high for their requirements, which might economically fall in a stage length under 75 mi.

▶ Engines—Multi-engine power seems to have received the nod. Engine failure operation conditions still have not been pinpointed—whether hovering or climb-forward flight considerations will prevail.

Transport copters will carry retractable gear, and the folding blade will be an advantageous feature to make the most of hangar space for copter storage and overhaul work.

Military Experience

Until the expansion in civil transport copter operation really gets underway, the military will continue as a main medium to probe and further uncover

PIASECKI H-21A

the numerous possibilities of rotary-wing aircraft.

What the military already has done gives only an indication of uses ahead. Marine Corps experience is a good example of what already has been accomplished and what is looked for with the helicopter.

▶ **Landing the Troops**—With the advent of the atom bomb it was realized that there would have to be a new approach to putting troops ashore from ships which would have to stay farther out at sea and be more widely dispersed.

Operational studies of this concept were begun back in 1947 with the Sikorsky HO3S, even though it wasn't considered to be the specific tool for the job. (It was about this time that requirements were talked up looking to a copter of the Sikorsky XHR2S type.)

The Piasecki HRPs also were used as an interim vehicle, with great effect.

▶ **Mountain Supply Line**—The first real combat employment of a copter came in Korea with the Sikorsky HRS, in September 1951. Marines look at the occasion as a history maker. One copter squadron was attached to the 1st Marine Division. Three days later the division was locked in its heaviest fighting, in the mountains. Supply became an almost insuperable problem—the 2,500 native bearers couldn't bring up the minimum supplies required.

The copter squadron did the job admirably. It is now revealed that in supplying two regiments for five days it averaged 322,461 lb. per day, 31,589 lb. per hr., with an average load of about 909 lb. About 326 loads were carried per day (actually flights per day), and roundtrip time was about 20 min. About 10 copters are reported to have participated.

Following this the squadron was engaged in other large-scale supply operations, evacuations and troop movements, even at night, displaying a flexibility that no unit had ever known before. Since then, the Marines have been learning more and more about how the copter fits into the tactical scheme, engaging in many ship-to-shore operations.

▶ **Dreams Come True**—As developed for the Marine Corps, the Sikorsky XHR2S is just what this service arm had been dreaming about. It has more power than can now be utilized and the R2800s can be souped up to meet extreme operational requirements. Aim wasn't to get the fastest copter—the speed obtained is considered a dividend over and above the requirements laid down.

The Marine Corps could not use efficiently a larger copter now. The HR2S was tailored size-wise to fit the

carriers which were expected to be used in transporting the copters to areas where they would be needed. Size of carrier elevators and hangar decks was the controlling factor.

Even so, there is an upper limit to the size an assault copter should attain, although this has not yet been resolved. A controlling consideration is that not too great a concentration of troops is considered advisable for initial assault—it would be analogous to putting too many eggs in one basket.

The HRZS will be pushed to its limit by the Marine Corps to forward all-weather flight development. This phase of operation has top priority in targets now under the sights. Other service arms using rotary-wing aircraft undoubtedly have the same attitude on the subject.

▶**Pushing for Speed**—More speed for military copters is seen as a near future target. This would permit more runs in a given length of time, regardless of the type of copter used—assault, transport, cargo. Faster runs would also decrease vulnerability.

Just how much of a speed jump is considered feasible is not clear, although today's copter speeds are considered comparatively low.

▶**Raising the Lift**—The need for very-heavy-lift copters may be solved by tip-driven rotors, to eliminate shafting problems involved in delivering torque from internal engines.

Noise in these jet tip-driven machines may be very disturbing factor as distinguished from the fixed-wing jet plane, where the noise is behind the pilot. In the tip-driven copter, the pilot is in the middle of a noise circle, which probably is most intense during hovering. This operational factor will require considerable study.

▶**One-Man Copters**—The "individual" copter—a rotor-seat combination, or a strap-on arrangement—isn't seen as a promising military development of the future.

Even as a one-man job for infiltration, it does not appear feasible. This same operation could be accomplished more effectively and less dangerously with a two-place conventional copter as the put-down medium.

Convertiplones

The convertiplane is thought of by some in the industry as the logical development or refinement of the copter—a sort of mongrel configuration embodying copter and fixed-wing characteristics, justified mainly on the basis of the increased level flight speed it promises over the pure copter.

A convertiplane speed of about 300 mph would be very attractive for some operations.

Others do not see it fitting into the aerial picture at all—they say it is not practical as a copter or as a fixed-wing plane.

▶**What Is It?**—The question frequently arises: "What is a convertiplane?" The definition necessarily must be loose and flexible and include aircraft embodying characteristics of both the copter and the fixed-wing configurations.

Those who draw a fine line of distinction contend that in a true convertiplane, initial vertical lift and the subsequent translational flight come from the same overall propulsive system. Where this vertical lift and forward propulsion come from separate systems, the aircraft frequently is called a compound type.

Generally speaking, the convertiplane is far behind the state of copter perfection—development-wise—the two might not even be considered as being "in the same ball park." The convertiplane involves more detail than the copter, more gearing.

▶**Not So Simple**—Whereas during conferences and on paper the convertiplane has been made to appear a relatively simple proposition, the effective accomplishment of such an aircraft is a tough problem even for such big and experienced builders as Bell and McDonnell. These companies, both engaged in prototype development, have copter and fixed-wing know-how; there is a good bit of each type in the convertiplane.

McDonnell's convertiplane prototype already has been unveiled (AVIATION WEEK Feb. 15, p. 17). It combines piston-propeller power with jet-driven rotor blades, has small wings.

In contrast, the Bell convertiplane will feature large slow-turning rotor-propeller combinations swiveling on the wings, acting as rotors for takeoff and letdown, and as propellers when tilted forward for translational flight (AVIATION WEEK Jan. 25, p. 16). Because it is slated for the Army, it should emerge as a "workhorse" type.

Indications are that windtunnel studies show that both Bell and McDonnell prototypes will have good performance.

For highspeed convertiplane applications, the jet powerplant is going to figure largely. One application seen as an efficient answer is a tip-mounted ducted fan, with the engine vertical for takeoff and rotated to horizontal position for translational flight.

The Navy, too, is interested in the convertiplane, may even own a piece of existing military contracts.

It will be a long time, development-wise before any commercial interest in the convertiplane is more than just casual—except, perhaps, for the compound type.

Human Factors:

Man-Machine Teamwork Is Key To Best Use of Weapons Systems

Proper consideration of human factors can make the difference between success and failure of weapons systems which must be used and maintained by men.

If and when pushbutton warfare arrives there will still be somebody who will push the button.

Somebody else will have to wire the circuits, somebody will have to maintain them, and somebody will have to think up improvements. Even if you don't carry this reasoning any further to include the people who design and produce pushbuttons and the people who hire and train those people, one very evident fact still stands out.

There will always be people.

This is the fundamental commandment in the study of human factors.

▶**Basic Truth**—This simple statement has been around for some time, recognized to a greater or lesser degree.

But it has been only recently that aviation has begun to worry about the human factors relating men to the machines they fly in.

It has happened because man's evolutionary pattern has been outraced by the pace of technology during the past century. Today, in many cases, a military man can just about cope with the new conditions and artificial environment imposed by the weapons he is to use.

It is especially true in combat aircraft.

Look at a B-47 pilot, who senses through his hands and eyes and ears a precise flight path balanced on a knife-edge between high-speed buffet and low-speed stall. He is out of his element.

Without his pressurized cabin, his partial pressure suit, his oxygen mask, he will die. Without a dark visor and non-reflective paint, he will go blind. Without self-confidence, training, a right frame of mind, he will break under the strain.

He lives in spite of being a human, not because he is. The gadgets that crowd his cockpit and chafe his hide, the escape and survival equipment under his buttocks, the psychiatric interviews and the medical reports will keep him alive.

That's one way to look at human factors work—as a study of the ways to keep a human alive.

Human factors endeavor falls generally in three broad areas: aero medical sciences, human engineering and human resources.

▶**Aero Medical Sciences**—Aviation medicine is one specialized study among the many listed under this broad heading. The Aero Medical Laboratory at Wright Air Development Center of the USAF Air Research and Development Command has a project list which includes protective clothing of all types, inflight feeding, survival equipment, a resuscitator and a spray-on burn dressing.

The extreme variety of the list is a tipoff to the complexity of the aero medical job.

It wasn't always so. Primary effort used to center around the flight surgeon, his chief concern was preventing disease and curing sicknesses or healing injuries. Once in a while he was able to give psychiatric care, if he had the background and the available time.

Now a flight surgeon trains as if he were going to be a pilot, he frequently flies on training or routine missions with the men under his care.

There is considerable aero medical research directed towards methods of helping a man stay alive in the alien environment of the cockpit.

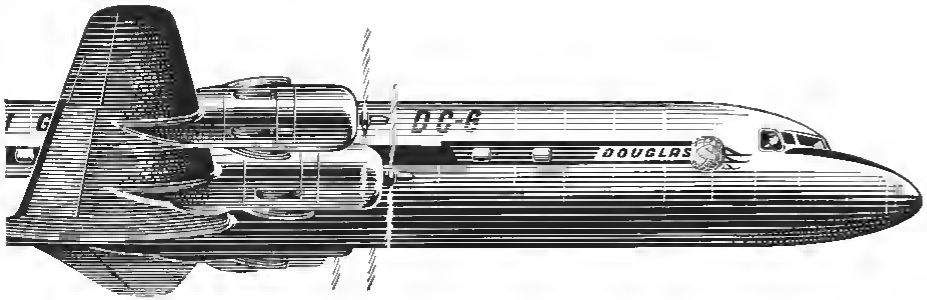
What effects do sonic and ultrasonic vibration frequencies have on pilots and ground crew? What is the toxicity of a new lubricant used in a jet engine, from whose compressor contaminated air may be bled into the cockpit? How old can a pilot get before he must be grounded?

These are some typical problems of the aero medical sciences.

▶**Human Engineering**—Here the problem is to engineer the machine so that it can be operated by a human of normal dimensions and appendages.

Every engineer who has ever designed a plane or a component knows that once in his career he has called for a rivet where no human hand could hold a bucking bar to back up the rivet. Those same engineers have not had an awareness of the pilot's problems either. They have located switches in open locations where installation and maintenance was simple, the only trouble was that a pilot would need either a reverse jointed arm, or a third arm to flip the switches.

Out of wartime cockpit engineering came many bitter experiences. One airplane had a gear retraction lever in the



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JAL *Japanese* • KLM *Netherlands* • LAI *Italian* • *LAN *Chilean* • NATIONAL *U S* • *NORTH AMERICAN *U S* • NORTHWEST *U S* • PAL *Philippine*
PANAGRA *U S* • PAN AMERICAN *U S* • SABENA *Belgian* • SAS *Danish Norwegian Swedish* • SLICK *U S* • SWISSAIR *Swiss*
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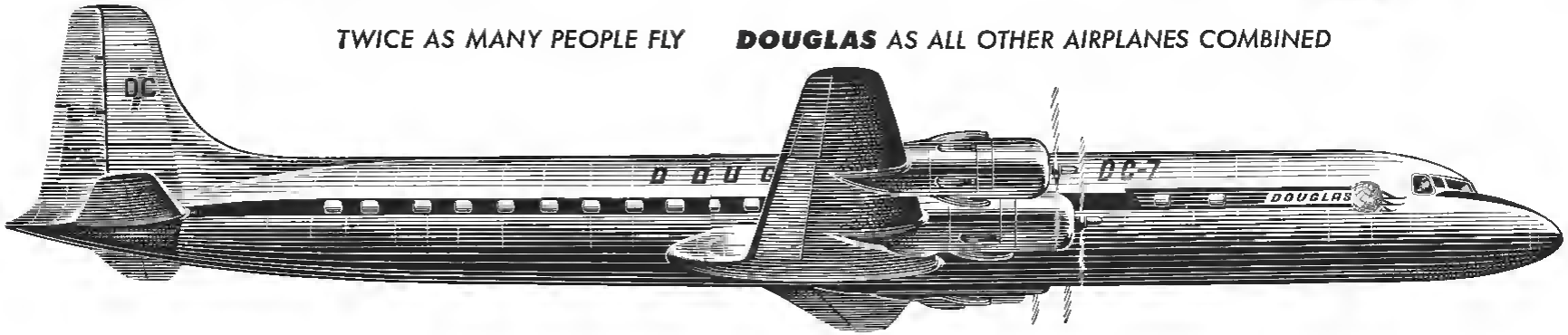


■ HUMAN FACTORS

identical spot where another had the tailwheel lock. A canopy release was on the left in one model, a later modification put it on the right.

Pilots would fly these types interchangeably, a high accident rate was the inevitable result.

Some observers of human engineering believe that the greatest single contribution of this phase of human factors is in the great advances made in standardized cockpit layout, control shapes and motions.

▶ **Human Resources**—This phase of human factors work considers the relation of the individual to his environment. Specifically, methods of selection of flying personnel, their training and promotion would be studied in this field.

But there is a broader aspect opening out of the relation between man and the world around him. The complexities of psychological warfare, the impact of nuclear weapons on a social or political group, the several phases of intelligence are all part of the human resources picture. So is group and individual morale.

So human factors in general can spill over into almost any line of endeavor, simply because the study is based on the fact that there'll always be people.

In the Air Force, three former ARDC human resources research units recently were integrated as the AF Personnel and Training Research Center.

Under one heading come these research laboratories, indicating the range and magnitude of human factors work in just one USAF command. Personnel Research and Skill Components Research, Aircraft Observer Research, Training Aids Research, Armament Systems Personnel Research, Crew Research, Basic Pilot Research, Interceptor Pilot Research, Officer Education Research.

It has taken designers and engineers a long time to realize that human limitations and frailties ultimately determine the effectiveness of hand-operated weapons. There is still considerable controversy between the proponents of pilot comfort and those who favor the Spartan approach. There are still those who believe that an aircraft technician is created by command and not by ability.

But the fact that there has been a continuing undercurrent of consideration of the human angle is encouraging. From first awareness of the problem, through initial exploratory contacts to partial understanding, the study of human factors has grown at an increasing rate.

It promises to be one of the most important phases of technology ever considered in aircraft research, development and design.

DOUGLAS DC-7

Airline Gains Continue as . . .

Air Transport Records Its Biggest Year

By Frank Shea, Jr.

The air transport boom continued to flourish in 1953, as the airline industry experienced the biggest year in its history. New peaks topped almost all previous records.

• **Revenues** of U. S. scheduled and non-scheduled airlines hit a record high of about $1¼ billion for a gain of about $140 million over 1952.

• **Total revenue ton-miles** climbed up around the 2¼-billion mark for an increase of approximately 260 million.

• **Domestic trunklines** accumulated more than 14 billion passenger-miles, a jump of nearly 18% over 1952.

• **U. S. international flag-carriers** experienced record traffic gains, as well as a big rise in net operating income. Total operating revenues increased by more than twice as much as total operating expenses.

Continued gains are forecast for 1954, both domestic and international but they are not expected to be quite as sharp.

Traffic in the last six months of 1953 did not maintain the very favorable rate of increase it enjoyed during the first half of the year, and this is taken as an indication of a slight leveling-off of the boom that has characterized the industry since 1950.

Heavy deliveries of new aircraft are causing a drop in load factor (payload as a percentage of capacity), and, at the same time, higher expense allowances to amortize the new equipment.

Higher overall operating costs, possible subsidy cuts and heavier competition from foreign-flag carriers are also big factors.

But the industry, on the whole, is optimistic. The trend is still upward, and most carriers are looking forward to another big year.

▶**Prediction for '54 Even Better**—The 1954 forecast for all the world's airlines, excluding those of Communist countries, is a 10% payload increase over 1953. International Air Transport Assn. predicts that its 69 member airlines, who presently handle 85% of the world's commercial air traffic, will up their capacity by 10%.

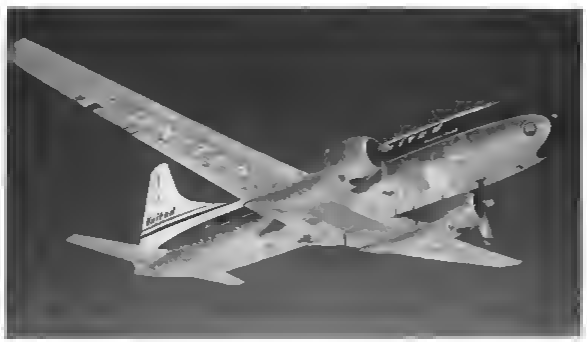
IATA estimates that carriers will spend about $200 million for over 300 transports scheduled for delivery during 1954 alone.

So the world wide industry outlook is for another record-breaking year, with gains not as marked as last year but still substantial.

▶**Cause for Optimism**—Optimism of U. S. carriers is based on the following trends.

• **Domestic trunklines** continue to make strong inroads in rail traffic. Trunkline passenger-miles were approximately one-half of first-class in 1948. Today, they are about 70% greater than Pullman type traffic and about one-half of the total rail passenger traffic excluding commuting.

• **Coach service** is still on the upswing and continues to be a significant factor in airline expansion. This type of traffic has made tremendous gains, in many instances more rapidly than standard



CONVAIR 340

LOCKHEED 1049C

service. Big factor is that it has brought air travel within reach of the lower income brackets.

Airlines are now catering to these groups, consistently extending coach service to an increasing number of cities. The experiment began with three cities in 1948. This number jumped to 27 the following year, and by 1951 a total of 33 cities was served by aircoach.

In 1952, domestic coach traffic accounted for about 20% of combined coach-first class traffic, covering 47 cities. Last year, it climbed to 30% of the total as seven more cities were added. Even stronger gains are forecast for 1954.

• **Trunkline mail revenue** is expected to pick up substantially during the year. Big factor here is the growing Post Office experiment of shipping preferential first-class mail between major cities by air instead of rail where costs are competitive. This should offset the decline in military mail.

Post Office experiment presently encompasses service between New York/Newark and Chicago, between Washington, D. C. and Chicago, as well as New York, Chicago and Washington to major cities in Florida.

Rates on the New York/Newark-Chicago run are set at 18.66 cents per mail ton mile, while Washington-Chicago is 20.04 cents. American, Capital, TWA and United are the carriers involved.

Delta C&S, Eastern and National Airlines are participating in the Florida segment. Delta and Eastern, from Chicago to Jacksonville, Tampa and Miami, receive 20.04 cents per mail-ton mile. National and Eastern receive 20.04 cents from Washington and 18.66 cents from New York/Newark.

Post Office also has enlarged the experiment to include local service carriers, holding that their services could be used in emergency instances where movement of surface mail would otherwise be delayed.

In the light of initial success in these test cases, Air Transport Assn. is urging airlines to give full support to a nation-wide expedited mail program in which all first-class mail would go by air when the distance to be covered is more than 400 mi.

ATA proposes a straight five-cent per ounce postage rate for all non-local first-class mail, including domestic airmail. Such a program would increase domestic airmail volume by an estimated 117 million ton miles annually which, at prevailing rates, would pay the carriers approximately $55 million.

It is considered doubtful that such an extensive expedited system will be put into effect during 1954, but it could come soon. There is a definite trend toward more air transportation of surface mail, and as it gains momentum, results will show up in trunkline mail revenues.

• **Lift capacity** of domestic and international scheduled air services has gained 42% over the past three years, while operating aircraft have increased only 17%.

There were 1,336 aircraft in operation as of June 1953, compared with 1,142 in mid-1950. However, these planes, mostly larger and faster types, can carry a billion ton miles a year more than the 1950 fleet.

A greater percentage of available ton-miles continues to be used. In 1950, domestic trunklines had 1,584 million ton miles available, filling 849 million. But last year, with 2,629 million ton-miles available, revenue use climbed to 1,542 million.

• **Fleet additions** last year included five transport models that were not in service in 1950. Convair 340, carrying 40 passengers. Douglas DC-6B, seating more than 60. Lockheed 1049C Super Constellation, with capacity for more than 70. Martin 4-0-4, holding about 40, and the Douglas DC-7, with a maximum capacity of 95.

Deliveries of the Convair, Lockheed and the Douglas planes will continue throughout 1954.

Leader is the DC-7, latest addition

MARTIN 4-0-4

to airline fleets. This Turbo Compound engine transport, with a maximum speed of 410 mph., may be the last piston engined airliner produced in the U. S. prior to the arrival of jets.

Cutting hours off flight schedules the DC-7 alone should be a major factor in boosting passenger traffic in 1954.

• **Outstanding 1953 safety record** of the airline industry also should lure more passengers to air travel. Combined U. S. domestic and international scheduled carriers achieved a rate of 0.48 passenger fatalities per 100 million passenger-miles last year, compared with the 0.9 figure of 1952.

International operators lowered their 3.1 fatality rate of 1952 to 0.06. These carriers completed a full year of fatality-free operation last August for the eighth time in their history.

Nonsked Picture

Large irregular carriers had the only poor safety record, registering their third highest fatality rate since 1946—approximately 10.6 deaths per 100 million passenger-miles.

The fatality rate is but one of the nonscheduled airlines' big worries during 1954. Politically and economically, the outlook is none too bright. Main reasons:

• **Government crackdown** on nonsked violations of CAB regulations restricting non-certificated carriers from route-type operations.

• **Military contract reductions** due to budget cuts and Korean truce.

• **Increased competition** among themselves, as well as with scheduled airlines and railroads. Rails are cutting rates in bid for official troop movements, despite upward trend of other rail fares.

▶ **Chances for Survival**—A few nonskeds eventually may win certificates, and a few more might survive on strictly charter work, which CAB permits.

The others have two possible major means of survival:

• **Government easing** of certification requirements through changes in present attitudes of CAB, the Administration and Congress.

• **Favorable interpretation** by a federal court of the Civil Aeronautics Act and CAB powers under it.

• **More government contracts** from military, Post Office and other agencies.

Such developments are not forecast for the immediate future.

▶ **The Problem**—The nonsked "problem" arose after World War II when many persons bought or leased surplus aircraft, and CAB waived certification requirements for them to fly charter-type services. Result was that they were called "nonscheduled airlines."

To win the privilege of flying scheduled air service, an airline must prove

U.S. Scheduled Air Transport Industry—1953

Airline	Total Employes	Annual Payroll ($)	Unduplicated Route Miles	Scheduled Revenue Passenger Miles	Total Scheduled Passengers Flown	Total Cargo/Mail Ton-Miles	Total Revenues ($)	Equipment (Excluding Interchange)
DOMESTIC TRUNK (Including foreign operations)								
American Airlines	18 726	—	10,831	2,981,972,000	8,817,000	83 143 000	208 305 859	NF 77 CV-240, 25 DC-6B, 87 DC-4, 8 DC-7. AC: 13 DC-4. C: 7 DC-4. Charter: 1 DC-4.
Braniff Airways	4,004	18 000 000*	15 576	536 284,000	1 313 798	8 081 371	40 000 000*	10 DC-3, 8 DC-6, 23 CV-340, 7 DC-4, 1 C-47
Capital Airlines	4 440	24 000,000	5 160	710 000 000	2 248 598	9 424 784	45 580 524	24 DC-3, 24 DC-4, 1 C-47, 1 C-54, 12 Connie
Colonial Airlines	773*	2 901,081	3 013	131 520 556	418 750	865 485	9 000 163*	NF: C. AC: 9 DC-4, 5 DC-4
Continental Air Lines	921	4 433,824	3 109	147 508 885	358 486	541,084	9 277 580*	NF: 10 DC-3, 7 CV-340, 2 DC-6B
Delta—C & S Air Lines	4,280	19,893,002	10,085	26 380 770	1,401 825	11,480 704	42 335 600	7 DC-4, 5 DC-6, 32 DC-3, 19 CV-340, 5 Connies.
Eastern Air Lines	10,263	88,000 000*	11,820	2 500 000,000*	4 750 000*	19 000,000*		NF: 60 4-0-4, 8 L-1049C. NF & AC: 16 L-1049, 10 L-749, 10 DC-4. C: 1 DC-4
National Airlines	2,010	10 900,300	3,859	818,000 000	580 278	9 384 179	35,382 007	5 DC-7, 8 DC-6B, 4 DC-4, 8 CV-340, 11 L-18, 1 S-55.
Northeast Airlines	904	4 007 011	2 273	91 598 933	463 712	1 098 609	5 497 440*	NF: 4 CV-240, 12 DC-3.
Northwest Airlines	3 420	28 000 000*	17,253	841 174 754	1 063 693	18 220 184	81,000 213*	10 B-377, 21 DC-4, 8 DC-3 and 8 DC-6B
Trans World Airlines	15 000		33,000	2,881,000,000	3,100,000	84 244 000		10 L-1049, 68 Connie, 53 4-0-4, 13 DC-4
United Air Lines	14 021	77 836 000	10 809	2,717 497,833	8 080 740	50 852 704	172 987,290	61 DC-6B, 43 DC-6, 8 B-377, 42 CV-340, 28 DC-4, 35 DC-3
Western Air Lines	1,813	8 743 763	6,496	330 115,000	887 354	3,540 409	22 379,000*	NF: 6 DC-3, 4 DC-6B, 10 CV-240. AC: 8 DC-4
TERRITORIAL INTERNATIONAL								
Caribbean Atlantic Airlines	175	326 000*	300	3,744 379	120,491	31,027	1 108 280	5 DC-3
Hawaiian Airlines	515	3 541 208	404	52 068 819	384 378	1 492 822	4 861 530	8 CV-340, 7 DC-3. C: 3 DC-3
Pan American-Grace Airways	1 838		8,794	169 088 000	124 819	8 583 722		NF: 8 DC-6. NF or AC: 9 DC-3. AC: 2 DC-6B, 3 DC-4. C: 1 DC-3
Pan American World Airways	17,254	84 290 500	62 500	2 815 108,000	1 867 275	74 441 448		29 B-377, 31 DC-6B, 8 L-49, 27 DC-4, 13 Convair, 8 DC-3.
Trans-Pacific Airlines	207	808,414	1,007	19,788,187	158,107	107,729	1,824 450	8 DC-3
LOCAL SERVICE								
Allegheny Airlines	486	2 102 706	2 321	81,231,848	212 040	2,014 500	4 079,750	13 DC-3
Bonanza Air Lines	201	983 020	1,448	18,245,300	63 081	88 000	1 820,000*	6 DC-3
Central Airlines	304	1,005 000	1 428	8,397,000	42 400	681 772	2 075,000*	NF: 6 DC-3
Frontier Airlines	550	2 070 000	3,000	32,381,000	127 708	865 088	4 009 600	NF: 12 DC-3
Lake Central Airlines	207	1,010,000	1,445	8,347,000	56 511	107 120	1 933 420*	NF: 7 DC-3. Military contract: 1 C-46 leased.
Mohawk Airlines	328	1,488,078	1 140	27,112,000	103 078	172 018	2 861,262*	10 DC-3
New York Airways	90	375,080		5,789	1,838	41,631		5 S-55.
North Central Airlines	620	2 525,540	2 650	37,025,311	217,882	274,453*		NF: 19 DC-3
Ozark Air Lines	384	1 750,000	2,705	20,843,000	124 448	104 220	3 327,587	NF: 13 DC-3
Piedmont Aviation	743	3 011,000	2 733	88,780,178	309 773	434 180	5 744 618*	18 DC-3
Pioneer Air Lines	880	1 842,842	1 272	40,780,223	149 860	330 006	3 048 540*	NF: 9 DC-3
Southern Airways	410	1 707,540	1,032	10,258,492	112 328	107 813	3 341 834*	NF: 10 DC-3
Southwest Airways	323	1 791,007	1,214	2 533 998	178 817	244 495	3 300,548	NF: 9 DC-3, 4 2-0-2
Trans-Texas Airways	509	1 844,539	3,420	20 934,000	97 384	244 347	3 461 738	18 DC-3
West Coast Airlines	370	1 800 300	6,025	8,509 253	181,314	114 308	3 319,484	18 DC-3.
MAIL & CARGO								
Flying Tiger Line[1]	1 359	9 474,517	—	NA	NA	51 298 220[2]	23 840 294	27 C-46, 7 C-54, 4 DC-6A.
Helicopter Air Service	45	808,000*	614	NA	NA	2 848 500*[3]	525,000*	9 47-D, 1 47 D1
Riddle Airlines	177	997 334	2,080	3,486 832	16 589,568	10 825 043[2]	2 836 384	C: 9 C-46

* —Approximate. In some cases these are preliminary unaudited figures.

NA—Not applicable.

[1] Flying Tiger Line and Slick Airways merger was approved by Civil Aeronautics Board on January 7, 1954. Corporate name: Flying Tiger Line.
[2] Cargo ton-miles.
[3] Mail ton-miles.

Equipment Code:
AC Aircoach.
C Cargo.
NF Normal fare.

Source: Airline reports to AVIATION WEEK.

public convenience and necessity for its proposed route services.

Many nonskeds expanded their services with demand and became, in effect, scheduled airlines without certificates. Then they began pushing for certification.

CAB decided in the transcontinental coach case that there was no need for new certificated aircoach services. But the nonskeds have continued fighting for rehearing through the courts, Congress, the Administration and CAB.

Some have violated Board restrictions, but CAB has been hard put to stop this through enforcement proceedings, largely because of the delays of due process of law in the courts.

The wheels of due process grind slow, but the Board's machine of enforcement action against nonskeds is speeding up

Repeated court precedents are narrowing the issues

1954 should see the nonsked problem partially, if not wholly resolved

Helicopters

Last year furnished ample evidence that short-haul commercial use of the helicopter is here to stay Chief developments

• **Inauguration** of first scheduled passenger service in U S by New York Airways, flying Sikorsky S-55s between New York City's three major air terminals—La Guardia, Newark and Idlewild

• **Continued growth** of Los Angeles Airways and Helicopter Air Service, Inc, of Chicago, both carrying mail and cargo

• **Unveiling** of the giant Piasecki YH 16, with capacity for 35-40 passengers.

• **Sabena Belgian airlines'** introduction of the first international helicopter passenger service between Brussels and Lille, France and between Brussels-Antwerp and Rotterdam in Holland Sabena has a fleet of S-55s

Early 1954 developments make an even stronger case for the helicopter

• **National Airlines'** inauguration of service to resort areas within a 15 mi radius of Miami, using S 55s

• **Successful flight** of the new 26 passenger, 150 mph Sikorsky S 56, reported to equal DC-3 performance, besides having inherent advantages of the helicopter

During the coming year, New York Airways expects to begin regular service to downtown New York City The only thing that is delaying this program is the location of suitable heliports The carrier also hopes to develop commuter service extending over its present suburban mail routes

Both Los Angeles Airways and Helicopter Air Service, Inc, hope to begin scheduled passenger operations before the year is out.

All carriers eventually plan to replace their present fleets with higher speed, larger-capacity aircraft But National has jumped the gun and secured an option on the first commercial version of the S 56

Indications are that the helicopter will be the answer to the airline industry's short-haul traffic problems. ATA forecasts that intercity helicopter passengers will reach 6 million a year by 1960, with copters flying a third of the intercity traffic by 1970

International

Having led the scheduled U. S airline industry to record total operating profits last year, U S flag carriers have cause to look forward to another big year

Flag lines owe most of their 1953 profit to final agreement with CAB on "fixed" mail subsidy rates, including profit Most mail and subsidy pay reported for years before 1953 were on a "temporary" break-even basis

Increased tourist service should account for a substantial traffic jump in 1954. Despite slight fare increases scheduled for North Atlantic routes, the general tendency of U S. carriers is toward lower tariffs

Indications are that the U S operators attempted to fight the North Atlantic increase when it was proposed at the IATA meeting in Honolulu last October, but rather than buck IATA they went along in hopes of getting compromise reductions in other areas

► Fare Incentive—General feeling is

WORLD AIR TRAFFIC GAINS 1937-53

(Scheduled Services)

	Miles Flown	Passengers Carried	Passenger-Miles	Cargo Ton-Miles	Mail Ton-Miles	Average number of passengers per aircraft	Average distance flown per passenger
	millions					(number)	(miles)
1953	1 170	55 0	29 600	730	196	24.8	356
1952	1 050	46 0	25 540	681	175	23.6	547
1951	975	39 6	22 280	612	160	21 9	590
1950	865	31 2	18 000	518	143	19 1	544
1949	805	26 8	14 400	391	126	17 5	548
1948	760	23 8	12 300	306	114	16 5	552
1947	765	21.0	11 700	207	96	16.1	559
1937	160	2 5	861	n.a	n.a	5.5	350
	INCREASE OR DECREASE BETWEEN YEARS						
1952-53	+ 10%	+ 18%	+ 16%	+ 7%	+ 8%	+ 6%	+ 2%
1951-52	+ 8%	+ 13%	+ 15%	+ 8%	+ 9%	+ 6%	+ 5%
1950-51	+ 13%	+ 40%	+ 20%	+ 10%	+ 12%	+ 15%	- 2%
1949-50	+ 8%	+ 20%	+ 17%	+ 33%	+ 13%	+ 10%	- 1%
1948-49	+ 6%	+ 10%	+ 17%	+ 40%	+ 13%	+ 8%	- 0%
1947-48	+ 12%	+ 10%	+ 10%	+ 53%	+ 30%	- 1%	- 0%
1947-53	+ 40%	+ 140%	+ 143%	+ 270%	+ 112%	+ 48%	- 5%
1937-53	+ 601%	+ 2 040%	+ 3 340%	n a	n.a	+ 360%	+ 27%

Note Excludes USSR and China N A — Not Available

Source International Civil Aviation Organization

Airline Subsidy Trends

DOMESTIC	1953	1954	1955
Group 1:			
American	$1 0	0	0
Eastern	0 0	0	0
TWA	0 0	0	0
United	1 0	0	0
Group 2:			
Braniff-MCA	2.3	0 8	0 5
Capital	1.0	0	0
Delta-C&S	1.5	0	0
National	1.3	0	0
Northwest	4.0	0	0
Western	0 0	0	0
Group 3:			
Colonial	1.1	0 8	0 8
Continental	1 2	0.7	0 7
Northeast	1 1	1.0	1 0
Piedmont	1 2	1.0	1.5
Pioneer	1 1	1 0	1 0
Group 4:			
Frontier	2.4	2.0	0 9
Mohawk	0.9	1.0	1.0
Southwest	0.8	1.1	1 1
Group 5:			
Allegheny	1 0	1 8	1 8
Bonanza	0 0	0 0	0 0
North Central	1 2	2 0	0 5
Ozark	0 8	2 0	2 0
Southern	1 4	1 9	1 8
Trans-Texas	1.6	2 6	2 0
West Coast-Empire	1 2	1.6	1 0
Group 6:			
Central	0.9	1 7	1.7
Lake Central	0 0	1 0	1.0
HELICOPTERS			
HAS (Chicago)	N.A.	0 4	0 4
Los Angeles	N.A.	0 8	0 8
New York	N.A.	1.1	1 4
INTERNATIONAL & OVERSEAS			
Trans-Atlantic			
Pan American	10.6	0 0	0 0
TWA	4.2	4.3	4 4
Latin America			
Pan American	4 0	11 2	11 2
Braniff	2.0	3.0	0 9
Delta	1.0	0.7	0.7
Panagra	1 8	2.2	2.2
Caribbean-Atlantic	0 2	0.1	0 1
Trans-Pacific			
Northwest	0 0	4 0	3 0
Pan American	7 0	7 0	7 0
Intra-Hawaiian:			
Hawaiian	..	0 0	0 6
TPA	...	0 0	0 0
U. S.-Alaska			
Alaska	...	1 2	1 2
Pacific-Northern		0 0	0 9
Pan American	0 0	1 3	1 0
Intra-Alaska:			
Nine lines	2 0	4 7	4 7
Five lines	0 4	...	...

Source: CAB revised report, September, 1953

that the easiest way in which new traffic can be gained is through reduction in the general level of fares Any such reduction, however, is dependent for its continuation on a considerable increase in the volume of traffic in order to maintain substantial airline revenues

A look at the record over the postwar years gives ample evidence of the increasing tendency toward lower international fares

In 1945, a oneway trans Atlantic crossing cost about $600 Last year, it was down to two thirds of that level for first-class travel ($395). As a result of Pan American World Airways' crusade for low-rate international tourist service, tourist fares went down more than 50%

This year, 25% cuts are scheduled for trans-Pacific fares Pan American also is effecting a $400 slash on its round the-world service, offering tourist flights for $1,300 as opposed to $1,700 for first-class

▶ **1954 Outlook**—Several factors will have tremendous influence on U S flag-carrier operations in 1954

• **Supreme Court offset decision**, if the full interpretation is applied, could result in a major reshuffling of flag-carrier routes, with TWA, Northwest, Braniff and Delta C&S possibly having to drop international operations

In its ruling, Supreme Court held that excess profits accruing from domestic operations must be offset against international subsidy requirements Since TWA, Northwest, Braniff and Delta all have combined domestic-international operations, the decision could be crippling

Pan American is the only airline that would stand to benefit, since it has no domestic service whatsoever

• **Heavy subsidy slashes** would also have drastic effects House Appropriations Subcommittee has cut $28 million off CAB's request for $50 million subsidy

Comparative transport costs
Direct operating cost per U. S. domestic plane-mile

9 mos. ending Sept. 30, 1953

	Flying operations (Cents)	Direct Maintenance (Cents)	Depreciation Charges (Cents)	Total Direct Oper Cost (Cents)
Douglas DC-3	31 97	11 10	2 62	45 69
Douglas DC-4	46 82	18 88	4 25	69 95
Convair 240	41.23	24 97	11 69	77 89
Convair 340	44 26	14 99	20.13	79 38
Martin 4-0-4	43 16	19 35	26 84	89 35
Douglas DC-6	52 15	21 03	16.17	89 35
Douglas DC-6B	55 69	18 10	23 48	97 27
Lockheed 749	61 36	27 16	15.19	103.71
Lockheed 1049	74 09	31 30	41 42	146 81
Boeing 377	84 56	49 09	36 62	170 27

Source: Air Transport Assn compilation of uniform Form 41 reports by domestic trunklines to Civil Aeronautics Board.

General industry feeling is that such an extensive cut won't stick, but reduction of some sort seems certain

• **Decisions on route cases**, several long-pending, could have far reaching effects on international routes This year possibly will see rulings on such controversial cases as New York Balboa Through-Service Proceeding, the Trans-Atlantic Cargo Case, Resort Airlines Miami Stopover Investigation and the States Alaska Case

• **Seasonal problem** must be resolved, especially on North Atlantic routes Consistent traffic gains will depend largely on stimulation of more winter traffic

Jet Transports

The era of the jet transport continues to loom on the horizon for both domestic and flag airlines. Leading contenders are Britain's de Havilland Comet 3 and Boeing's Model 707

▶ **Certification for Comet**—Pan American has three Comet 3s presently on order, with seven more on option But CAA certification is the big obstacle to be overcome before the Comet can see service on U S routes

As yet, CAA does not have sufficient information to estimate the possibilities for certification First model is expected to fly this summer, to beat the 707's first flight

CAA will be especially cautious about certificating Comet 3s in view of the six crashes of Comet 1s over the past 15 months Certification is considered doubtful in 1954

▶ **Boeing 707**—Boeing's 707 is expected to hold a considerable edge in speed and power over the Comets Data available indicates that the 707 will cruise in the near 600 mph class, presumably around 580 mph But the air liner may achieve block to-block speeds in normal transport operations as high as 550 mph for some distances.

This would give Boeing a considerable advantage over de Havilland, now quoting 470-mph speed for the Comet 1, 500 mph for the Comet 2 and

U.S. Scheduled Domestic Air Coach 1953

Airline	Passengers Carried			Passenger Miles			Load Factor (%)			Revenue		
	1951	1952	1953	1951	1952	1953	1951	1952	1953	1951	1952	1953
American Airlines	101 395	333 074	571,000	179,076	277,311,305	564,116,000	56 30	58 1	75 6	$7 000 000		
Bonanza Air Lines	—	1,768	6 726	—	451,000	695,000	—	46 0	52 35		$72 550	$34 900
Braniff Airways			6 732[1]			1,561			50.27			
Capital Airlines	117 263	237,256	266 047	106 616	116 476,000	131 762 000	52 62	59 96	56 67	4 106 127	4 115 000	
Colonial Airlines		6 135	36 607		2 352 233	31 555 355	—	56 56	91 01		102 980	515 634
Delta-C&S Air Lines		90 526	136 446	47 500	70 047,000	108 135 000		71 88	88 31		933 525	4,534 036
Eastern Air Lines	522 761	650 215	674 735*	302 003	520 701 000	855 250 000*	74 43	74 03		11 023 538	21 690 533	
National Air Lines	102 253	167 334	309 544	95 050	170 150 000	309 001 000	64 51	71 24	76 32	4,416 725	7 873,633	12,373 675
Northwest Airlines	99 277	222 615	310 415	111 354	211 256 000	261 740 371	76 88	68 76	66 53	6 360 000	12 000,001	18,631,702
Trans World Airlines	185,000	375 435	730 000	251 000	575 535 000	1 027 704 000	76 60	85		11 380 000		
United Air Lines	216 701	339 916	563 436	164 806	270 384 023	522 461 000	73 09	76 4	78 2	4 452 753	11 107 520	22 214,783
Western Air Lines	207 004	240 700	251 746	61 685	116 504 000	108 241 000	75 36	71 61	65 66	3,001 000	4,500,000	4,046,000*

*—Approximate. [1] One month only
Source: Airline reports to AVIATION WEEK

slightly more than 500 mph. for the Comet 3.

Designed for nonstop transcontinental and for trans-Atlantic service, the 707 is larger, heavier and carries more payload than the earlier Boeing Model 473 jet transport design or the current piston-engine Stratocruiser.

According to CAA, U. S. turbine-powered transports should be flying the nation's airlines within the next three to five years.

In a study by its turbine-powered transport evaluation team, CAA predicts that turbojet and turboprop transports will be flying domestically before they are used in international service.

Two principal developments are speeding introduction of jet airliners in the U. S.:

- **Accent on speed** brought about by DC-7s and Super Constellations.
- **Impact of British** turbine-powered transports.

Long-Ronge Outlook

Barring a sharp decline in the economy, U. S. airlines should be able to look forward to continued growth for the next several years at least.

U. S. is currently undergoing tremendous increase in living standards, where the ordinary citizen buys out-of-the-ordinary things. According to the National Planning Assn., this is a trend that means "the luxuries of yesterday become the necessities of today."

Travel is luxury to most people, especially air travel. But so are many other items on the American economy.

▶ **Wooing the Dollar**—As the standard of living increases, airlines will not only find themselves competing with other modes of transportation, but with a variety of "luxury" consumer goods and services.

Competition from other forms of consumer spending will be keen. The share of the consumer dollar that goes for travel by air will depend, in the final analysis, on how attractive air travel can be made for the growing mass market.

Other factors that should contribute to air transport growth:

- **Growing population** of the U. S. is shifting across the country to the West and Southwest. Long-range implications of this movement for air travel are tremendous. A big population on the West Coast means more cross-country travel—longhaul travel ideally suited to the airlines.
- **Large cities** and suburbs are attracting a large percentage of the population. This concentration is a big booster for airlines, since most air travel originates in large cities. More intercity travel is inevitable.
- **Commuter traffic** is a great potential for the helicopter. The copter has two big advantages over railroads for carrying commuter traffic. It does not require as much expensive urban real estate, and it can be shifted easily from commuter service to short intercity service for operation during slack commuting periods.
- **Business abroad** will represent a gradually increasing share of U. S. business and will require an increase in travel.

By 1960, the radius of business travel should extend into northern Canada, South America, West Africa and Western Europe—not just occasionally, but frequently. This entire area will be more closely knit together by high-speed transportation. Airlines offer the most expeditious service.

- **General decentralization** of industry offers still another potential air travel market.

From all indications, the long-range outlook for the air transport industry is a bright one. The potential is there. It remains for the airlines to exploit it.

U. S. Aircraft Engaged in Air Transportation

(AS OF DECEMBER 31, 1953)

Type of Operation	Service	DC-7	DC-6	DC-4	DC-3	1049	749	649	649	18	12	S-3	4-0-4	2-0-2	377	340	260	C-46	S-61	S-55	47D	CH-37B	HR-1	G-44	G-21A	PBY	PC-3	3-49	Total
(1) Sched Dom	Aircraft Utilized for Trunk and Feeder Serv. Only	0	62	70	200	10	18	0	37	11	0	0	100	26	0	98	13	0	0	0	0	0	0	0	0	0	0	0	735
(2) Sched Dom	Aircraft Utilized for Helicopter Service Only	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	6	5	0	0	0	0	0	0	0	17
(3) Sched Dom	Aircraft Utilized for "Cargo Only" Service	0	2	11	0	0	0	0	0	0	0	0	0	0	0	0	0	57	0	0	0	0	0	0	0	0	0	0	70
(4) Sched Dom.	Aircraft Utilized for Intrastate Service (ig. Acft.)	0	0	0	10	0	0	0	0	0	1	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15
(5) Sched. Int	Aircraft Utilized for International Service Only	0	42	56	88	0	0	0	3	0	0	1	0	0	27	5	14	17	0	0	0	1	0	3	12	3	1	1	247
(6) Sched Dom. & Int.	Aircraft Utilized for either Domestic or International Service	10	110	55	26	21	44	5	0	0	0	0	0	0	10	16	77	0	0	0	0	0	0	0	0	0	0	0	385
(7) Irreg Dom. & Int	Aircraft Utilized in Irregular Air Carrier Service	0	0	82	30	0	0	0	0	1	0	0	0	0	0	0	0	70	0	1	0	0	0	0	0	2	0	1	104
(8) Grand Total	Air Carrier Acft. in Domestic and Int. Service	10	216	244	420	31	62	5	40	12	1	1	100	30	43	119	104	144	6	7	5	1	0	3	12	5	1	2	1,833

NOTE. To find total of scheduled air carrier aircraft in Domestic Services, add 1, 2, 3, 5 and 6.
To find total of scheduled air carrier aircraft in International Services, add 5 and 6.

Aircraft identification by manufacturer:
Bell 47D
Bellanca CH-300
Boeing 377 Stratocruiser
Budd RB-1 Conestoga
Convair 340 Convair-Liner; 240 Convair-Liner; PBY Catalina.
Curtiss C-46 Commando.
Douglas DC-7; DC-6; DC-4; DC-3
Grumman G-44 Widgeon; G-21A Goose
Lockheed 1049 Super Constellation; 749 Constellation; 649 Constellation; 18 Lodestar; 12; S-3 Vega.
Martin 4-0-4, 2-0-2.
Republic RC-3 Seabee.
Sikorsky S-55 S-61

Source: CAA.

AIRCOACH GROWTH

Carriers Providing Service as of December

CITIES SERVED	1948	1949	1950	1951	1952	1953
Chicago	1	6	6	6	7	8
New York	1	6	6	7	8	8
Pittsburgh	1	2	2	2	3	3
Albuquerque	–	1	1	1	1	1
Amarillo	—	1	1	1	1	1
Atlanta	—	1	2	2	2	2
Billings		1	1	1	1	1
Birmingham		2	2	2	2	3
Cleveland		1	2	2	3	4
Detroit	—	2	3	3	3	5
Jacksonville	—	1	3	3	3	3
Kansas City	—	1	1	1	1	2
Knoxville	—	1	1	1	1	1
Los Angeles	—	3	4	4	4	4
Miami		3	3	3	3	3
Milwaukee		2	2	2	2	2
Minneapolis		2	2	2	2	3
Mobile		2	2	2	2	2
New Orleans		3	2	2	2	2
Phoenix		1	1	1	2	1
Portland, Ore.	–	2	3	3	3	3
San Francisco	—	1	2	3	3	3
Seattle	—	2	3	3	3	3
Spokane	—	1	1	1	1	1
Tampa	—	1	1	2	2	2
Washington	–	3	3	3	6	6
Wichita		1	1	1	1	2
Charlotte	—	—	1	1	1	1
Cincinnati	—	—	1	1	1	1
Great Falls	—	—	1	1	1	1
Houston		–	1	1	1	2
West Palm Beach	—	—	1	—	—	—
Dallas	–	—	—	1	1	3
St. Louis	—	—	—	1	1	2
Burlington, Vt.	—	—		—	1	1
Denver			—	—	1	1
Las Vegas	–	—		—	1	1
Long Beach	—	—	—	—	1	1
Madison	—	—	—		1	1
Norfolk	—			—	1	1
Omaha	—	—	—	—	1	1
Philadelphia		–	—	—	1	3
Rochester, Minn.					1	1
Salt Lake City		—	–	–	1	2
San Antonio	—		—	—	1	2
San Diego	–	—	—	—	1	2
Scranton	—	—	—	—	1	—
Syracuse	—	—	—	—	1	—
Boston	—	—	–	—		4
Buffalo	—	—	—		–	1
Chattanooga	—	—	—	—		1
Hartford	—	—	—	—	—	1
Indianapolis	—	—	—	—	—	1
Jackson, Miss.	—	—	–	–	—	1
Memphis	—			—	—	1
Oklahoma City	–		—	—		1
Shreveport	—			–	—	1
Total Cities Provided Coach Service	3	27	32	33	47	54

FAIRCHILD C-119

MATS Operation Set for Peace or War

World's largest air transport operation holds record of flying 500,000 persons over 115,000 miles to 38 countries without a fatality.

Military Air Transport Service, world's largest air transport operation, during 1953 carried 500,000 passengers without a fatality across 115,000 mi. of international air routes to 38 countries.

MATS is made up of three divisions:

• **Pacific Division.** Commanded by Rear Adm. William D. Johnson at Hickam AFB, Hawaii, this unit is responsible for air supply of U. S. Far East Forces in Japan and Korea, and military missions to individual countries as far as Dhahran, Saudi Arabia. Aircraft assigned to this division made 9,800 trans-Pacific flights in 1953, hauling 227,000 passengers and patients and 34,750 tons of cargo and mail. This is less than the 1952 record because of the Korean airlift cutback.

• **Atlantic Division.** Based at Westover AFB, Mass., and commanded by Brig. Gen. John M. Hopkins, this division directs transport operations across the Atlantic to Europe and Africa, linking with the Pacific Division at Dhahran. Atlantic Division also supplies strategic Thule AFB in Greenland. During 1953, Atlantic Division flew 208,648 passengers and patients and 38,526 tons of cargo and mail. Thule flights alone carried about 18,000 passengers and 5,500 tons of cargo. The Division plans to move soon to Dover AFB, Del.

• **Continental Division.** Maj. Gen. James S. Stowell commands this division from Kelly AFB, Tex. Its principal missions, in addition to air support, are air evacuation and training. Continental's operations also extend to Alaska, Canada and the Caribbean area. Its routes join with the Atlantic Division at Westover AFB and with the Pacific Division at Travis AFB, Calif. It carried 91,000 passengers and patients and 8,400 tons of cargo in 1953.

The three divisions during 1953 flew more than 1 billion passenger-miles, 132 million patient miles and 318 million ton-miles.

► **Routes**—Basic routes today are:

Mid-Pacific route from Travis AFB to Hawaii through Wake Island to Tokyo. Another route extends from Kwajalein to Guam, Manila and Saigon through India to Dhahran. The North Pacific route starts at McChord AFB, Wash., through the Aleutians to Tokyo.

North Atlantic route begins at Westover AFB through Newfoundland and Iceland to various points in Europe to Egypt and Dhahran. The other Atlantic route extends from Westover AFB through Newfoundland and the Azores to Scotland and Europe. Currently the Atlantic Division is running a passenger and cargo route from Westover to Thule AFB by way of Goose Bay, Labrador, and Sonderstrom AFB, Greenland.

Continental Division's basic aeromedical evacuation route runs from Travis AFB to Kelly AFB to Brookley AFB, Ala., to Westover AFB.

Within the framework of these routes, MATS operates other routes and schedules as military requirements demand.

► **MATS Planes**—Among the approximately 400 four-engine transport aircraft operated by MATS are the Lockheed R7V-1, fastest plane in the stable, the Boeing C-97, the Douglas C-74 (a MATS squadron at Brookley AFB operates all of these aircraft ever built) the Douglas C-124, the Lockheed C-121 and the Douglas C-118. Still a major factor in this airfleet is the Douglas C-54.

The twin-engine Convair C-131A will be added to the MATS fleet as an air evacuation plane in the very near future. It is the first aircraft with a special interior for aeromedical service.

Rescue craft include the Boeing SB-17 and SB-29, Grumman SA-16, Sikorsky H-5 and H-19, and the Piasecki H-21. Transition training planes are the North American T-6, Lockheed T-33, North American F-51 and Republic F-84, flight facility check plane is the Lockheed F-80. Other planes include C-47, WB-29, B-25, B-26.

Backing up the MATS fleet of transport planes is the Civil Reserve Air Fleet Plan. CRAF calls for the mobilization of about 400 civil transport aircraft and crews into the MATS structure in the event of a national emergency.

► **JCS Set Requirements**—Lt. Gen. Joseph Smith, who commands the entire MATS operation and its 100,000 military and civilian personnel from Andrews AFB, Md., is quick to point out that while MATS operates scheduled flights in the same manner as commercial airlines, his scheduled operations are based entirely on providing the airlift requirements directed by the Joint Chiefs of Staff. "The military situation determines the routes and schedules to be flown," he told AVIATION WEEK.

CHASE C-123

House Appropriations Committee, in a report on fiscal 1954 Defense Department funds, sharply criticized the MATS operation, stating that USAF directives had taken MATS far beyond its original mission of providing air transport for defense agencies. The committee claimed Air Force directives indicate that training and tactical support is the primary mission, and complained about the assignment of Air Rescue Service, Air Weather Service, Airways and Air Communications Service and Air Photographic and Charting Service as a MATS responsibility.

► **Business Basis**—The committee strongly urged that MATS be limited to air transport operations, and that it be established on an industrial fund basis similar to Military Sea Transport Service. Defense Secretary Charles Wilson has approved the idea. MATS itself maintains a studiously careful position. "We will operate MATS just as we are directed by higher headquarters," a top staff officer said.

Gen. Smith is proud of MATS' operational readiness, and that no U. S. serviceman, wherever he may be stationed, is more than 60 hr. away from a U. S. hospital.

"We are doing in peacetime what we shall be called upon to do in time of war," Gen. Smith said. "Our democratic way of life will not support fully manned peacetime military machines. But it is imperative that we maintain forces-in-being—a hard core. This applies to all military branches.

"Other elements of the Air Force are in constant training during peacetime toward the military commitment if and when an enemy strikes. As any other military unit, we too are concerned in wartime with supporting our combat operations. But, where other elements are concerned primarily with training,

DOUGLAS C-124

BOEING KC-97G

■ MILITARY TRANSPORT

we actually are fulfilling a peacetime military requirement."

▶ **Fly Super Connies**—MATS was established in June 1948 with the integration of the Air Transport Command and the Naval Air Transport Service. This was the first instance of combining two separate U. S. military services into a permanent organization.

The vice commander of MATS is a Navy officer—Rear Adm. T. B. Williamson. Four Navy transport squadrons (each roughly compares to a USAF group) are assigned to MATS. Two squadrons are based at Hickam AFB, one at Moffett NAS, Calif., and the other at Westover AFB. One of the Hickam squadrons flies R7Vs, the only Super Constellations assigned to MATS.

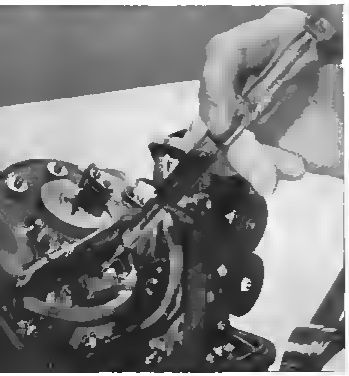
▶ **Technical Support Services**—Other side of the MATS operation is the technical support services which drew Congressional criticism for assignment to MATS. These include:

• **Air Weather Service.** This organization operates a worldwide meteorological service with detachments at all Air Force bases in the U. S. and abroad. Six reconnaissance squadrons, using WB-29s, are engaged in a constant search for vital weather information. They flew 11.2 million miles last year or about 56,300 flying hours. One squadron based on Guam made 105 penetrations into 18 typhoons. A force of 12,000 operates AWS' four weather centrals, seven forecasting centers, 253 forecasting units, 214 observing units and 68 upper air units in 26 countries. It is commanded by Maj. Gen. W. O. Senter, scheduled to be replaced by Brig. Gen. Thomas Moorman in April.

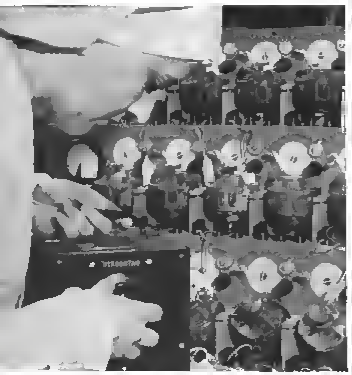
• **Airways and Air Communications Services.** This unit operates more than 2,000 facilities from 250 strategic sites around the world. Duties include operation of fixed aeronautical point-to-point and ground-to-air radio stations, airport control towers, navigation aids, and message centers where weather information is collected and transmitted. Highlight of last year's operations was the installation of the first of many RATCC (radar air traffic control centers). These centers enable AACS to establish precise radar control of aircraft approaches to military fields. AACS is commanded by Maj. Gen. E. Blair Garland with headquarters at Andrews AFB.

• **Air Photographic and Charting Service.** Production and distribution of charts, aeronautical publications and air target information are the prime responsibilities of APSC, which was assigned to MATS in April 1952. The unit also produced 131 reels of sound and silent film for USAF use in train-

Gyro assembly. Honeywell gyros are assembled in air conditioned, pressurized rooms guarded by a double air lock. To control lint and dust, workers are required to wear special caps and gowns.



Extreme care is taken—in every gyro operation. Here a hypo needle is used by operator to perform minute operation—that of cementing a tiny mercury switch into its bracket deep inside a gyro.



Quality mass production means operations like this run in test rack, where rotors are pre-tested for accuracy before gyro is completely assembled. Rack spins rotors at 21,000 rpm for 22 hours.

Got a job for an airborne gyro?

We have the gyro for the job

THE reason we can make this statement is that today at Honeywell we're *specialists* in gyros.

We are the leader in the field. With test and production facilities unequalled in the industry, we're tooled to produce thousands of precision gyros a month.

Honeywell's gyro line includes Vertical Gyros, Cageable Vertical Gyros, damped and undamped Rate Gyros and the highly sensitive, yet rugged line of fully floated Honeywell Integrating Gyros.

Our gyro 'family'—which was originally developed for use in Honeywell aeronautical control systems—is now available to manufacturers who require *precision* performance. A letter to Honeywell Aero Division, Dept. 658, Minneapolis 13, Minn., will bring full details.

The Honeywell gyro 'family' will continue to grow, as part of our complete line of controls for everything that flies. Because automatic control is important to aviation's progress. And *automatic control* is Honeywell's business.

MINNEAPOLIS
Honeywell
Aeronautical Division
2600 Ridgway Road, Minneapolis 13, Minn.

ing and orientation. Brig. Gen. Edwin M. Day commands the organization at Orlando AFB, Fla.

• **Air Rescue Service.** Operating 43 squadrons which fly the SA-16, the H-5, H-19 and H-21 helicopters, and SB-17 and SB-29 lifeboat carriers, ARS provides a global search and rescue service for USAF crews involved in aircraft accidents. This service is also available for civilian aircraft crews and friendly foreign aircraft. During the Korean war the 3rd Air Rescue Group in Japan and Korea completed 9,680 rescues within the combat area. ARS is commanded by Brig. Gen. Thomas J. DuBose. Headquarters are scheduled to move from Washington, D. C., to Orlando AFB in April.

• **Flight Service.** This unit delivers flight plan messages to bases of destination within the U. S. This is accomplished through a network of interphone and teletype lines connecting all military and Naval bases, direction finding station, Civil Aeronautics Administration air route traffic control centers and air defense control centers. New communications will connect FS centers with all very high-frequency and ultra high-frequency direction finding stations. Pilot formerly could rely on receiving bearings from a single DFS, can now obtain advice through the new Flight Service DF evaluation centers. Col. Harry J. Bullis commands FS, which is also scheduled to move from Washington, D. C., to Orlando AFB.

► **Ferrying and VIP Service—MATS** also operates an aircraft ferrying service under the Continental Division composed of three squadrons—two jet and one piston engine—based at Dover AFB, Long Beach AFB, Calif., and Amarillo AFB, Tex. The ferrying squadrons last year delivered more than 7,000 aircraft in the U. S. and overseas.

The 1254th Air Transport Group, based at Washington's National Airport, handles the special—VIP—missions. One of the longest flights made by aircraft from the 1254th was Vice President Richard Nixon's goodwill mission. The Lockheed C-121 flew 169 hr. and traveled about 40,000 mi.

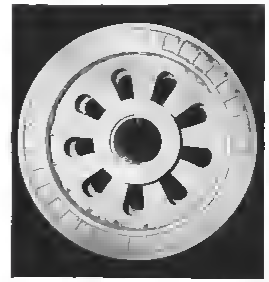
Another MATS mission is the support of the Strategic Air Command. Within hours after the Communists struck across Korea's 38th parallel, MATS was ordered to support the move of two SAC medium bomber wings to the Pacific. Two types of airlift are provided. First is the normal airlifting of SAC units supplies and equipment from the home station to the temporary duty SAC base. Second is en route support which provides service at MATS bases along the route to the destination. —GJMcA

MAGNESIUM *by ALCOA*

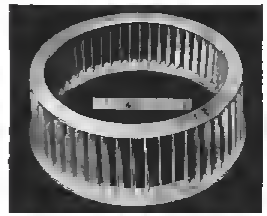
Aircraft engineers are taking a second look at magnesium! Until recently, this metal was considered best for only minor castings—but sound technical advances have been made in alloying, heating and casting this modern metal.

Today, Alcoa operates three magnesium foundries at Vernon, California, Cleveland, Ohio, and Buffalo, New York. At Alcoa's Buffalo Works, magnesium castings weighing upwards of three hundred fifty pounds are being cast! An example is the forward section of America's newest, most powerful jet engine in production—Pratt & Whitney Aircraft's revolutionary J-57. This leading engine builder makes full use of magnesium's strength and lightness. Other applications, too, like gear housings on giant helicopters, are cast of Alcoa® Magnesium. But size alone does not make these castings unique. Alcoa's team of magnesium experts also turns out tiny castings which weigh but a few ounces. The difference is team effort. From start to finish—from alloy selection to final inspection—these specialists watchdog every casting.

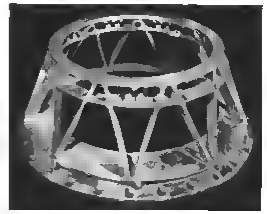
If you'd like more information on Alcoa's abilities . . . and facilities . . . just call your nearby Alcoa sales office. The number is listed under "Aluminum" in the classified section of your telephone directory. Or write: ALUMINUM COMPANY OF AMERICA, 1800-C Alcoa Building, Pittsburgh 19, Pennsylvania.



Extra-light aircraft wheels of Alcoa Magnesium—like this type, used on the Air Force's B-47 "Stratojet" bomber.



A challenge accepted by Alcoa—pouring the magnesium around stainless steel blades to form a solid, complex casting.



Another intricate job, this one a light weight engine support for a Pratt & Whitney Aircraft turbojet engine.

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ALCOA ALUMINUM

ALUMINUM COMPANY OF AMERICA

Airfreight Faces Uphill Struggle

Despite gains in 1953 and rate rise late in year, profits are still marginal; cargo carriers fight for part in mail plan.

By Richard Balentine

Although 15% more freight was moved by the nation's air cargo industry in 1953 than in the preceding year, airlines were well aware at the end of the year that they still were involved in an uphill struggle.

Roughly 300 million ton-miles of freight was carried during the year. Profits were marginal for the big trunk airlines. The independent cargo carriers did not fare so well.

Big factor seemed to be that the industry still had a long way to go, because the airfreight business represented one-tenth of 1% of all cargo carried throughout the country during the year.

▶**Profound Effect**—Four incidents occurred during 1953 which, by the end of the year, were beginning to have a profound effect on air cargo carriers.

- **Rate increase** averaging 12% in November.
- **Cutback** of the Pacific airlift.
- **Merger** of Flying Tiger Line and Slick Airways.
- **Postmaster General** Arthur Summerfield's mail experiment.

▶**Marginal Returns**—Civil Aeronautics Board increased the airfreight tariff (AVIATION WEEK Nov. 2, p. 74) as proposed by Slick and Flying Tiger earlier in the year. Slick contended that, due to higher expenses, the present rates produced marginal-to-loss returns on all-cargo service despite high load factors.

However, the Board's order became effective Nov. 20, too late to have much effect on 1953's overall freight business. Even with the rate increase, trunk carriers saw little chance of bettering their profits in any great degree this year.

Emery F. Johnson, vice president and general manager of Air Cargo, Inc., said airfreight would increase only about 25% in 1954.

"You simply can't make money in the cargo business yet," he declared, adding that any increase is simply the sign of "natural growth" of the industry.

▶**Airlift Phaseout**—Cessation of Korean hostilities in June forced a cutback in the Pacific airlift. By the end of the year, none of the trunk carriers were involved. Of the independents that had received military lift contracts, only California Eastern Airways, Overseas National Airways, Seaboard & Western and Transocean Air Lines remained.

By Mar. 31, all will be phased out as the Defense Department takes over the lift. Phaseout of the airlift will provide added capacity for commercial airfreight traffic during this year.

Loss of lift contracts by the other carriers involved placed some of the independent airlines in precarious financial positions.

▶**Boon to Industry**—Merger of the two biggest independent all-cargo airlines, Tiger and Slick, was viewed as a boon to the entire airfreight industry. Because the merger was not approved by CAB until Jan. 7 (AVIATION WEEK Jan. 18, p. 80) it had little effect on the two airlines's 1953 business.

William E. Hollan, Slick vice president-sales and traffic, said, however, that 1954 would be the biggest year yet for the newly formed consolidated Flying Tigers company. Time spent by the two firms in fighting each other in the past now can be concentrated on fighting the competition of the big trunk carriers, he said.

This, said Hollan, would bring about

Scheduled Airfreight—Revenue Ton-Miles (000)

	AMERICAN, TWA AND UNITED			FLYING TIGER, RIDDLE† AND SLICK	
	Express	Freight	Total	Freight	% of AAL, TWA, UAL Freight Figures
1950	23,117	76,597	99,714	60,084	78
1951	26,320	72,622	98,942	80,424	111
1952*	25,766	84,950	110,716	93,938	111
1953*	29,742	97,656	127,398	89,092	91

† Riddle freight services included before Mar. 24, 1951, are nonscheduled services only.
** 12 months ending Nov. 30th.*

AIR TRANSPORT

an improved and flexible freight service for the company. Combined, the two airlines will make up the world's largest airfreight fleet, with four DC-6As, 11 DC-4s and 45 C-46s.

Together they carried nearly half of the freight flown domestically in 1953.

▶**Successful Experiment**—Postmaster General Summerfield's experiment to fly a certain percentage of first-class mail by air between New York-Chicago and Washington-Chicago was pronounced so successful that it was extended last month to Florida.

Airlines now involved are American, Capital, Trans World, United, Delta-C&S, Eastern and National. Summerfield's experiment will have more effect on the volume of airfreight moved in 1954 than it had on 1953 traffic, since it was not begun until October of last year.

At the end of 1953, the all-cargo carriers were clamoring for participation in the mail plan. Robert W. Prescott, president of Flying Tiger, said of the experiment:

"It seems inconceivable that the all-cargo airlines will long be excluded from an experiment which promises so much by way of savings and improved mail service. . . . The airfreight industry is confident that some day, somehow the first-class and preferential mail will go by air, in cargo planes and at costs geared to cargo plane operation."

▶**Airfreight Fleets**—Equipment-wise, the air cargo industry continued to use the older Curtiss C-46s, Douglas C-47s and C-54s, many leased from the Air Force, and the newer Douglas DC-6A. During the year, National returned its C-46s to USAF and replaced them with cargo-type Lockheed Lodestars.

Best bet for the present and immediate future appeared to be the DC-6A, cargo version of the DC-6 line. Air Cargo's Johnson said there is no market for a cargo type craft at this time.

▶**Billion Ton Miles**—Although airfreight appeared to be a slow-growing business in 1953, sales research experts in both airline and aircraft manufacturing companies predicted the billion ton mile mark might be shattered by 1960.

Prescott, of Flying Tiger, was more optimistic. He said: "If the general business level stays at or near its 1953 highs, the airfreight industry should enjoy a record-breaking year of growth.

"Airfreight is, and should be, a separate industry, not a mere adjunct to the passenger business. It is a specialized service to meet specialized requirements. In fact, passenger traffic operations do not mesh well with freight flying, which explains in part the general lack of interest in airfreight development among combination carriers."

Supersonic Research Looks for New Answers as . . .

Speeds Get Higher, Problems Tougher

Two dramatic highspeed flights marked significant points in aeronautical engineering progress during 1953:

• Faster than any research aircraft had ever flown, the Bell X-1A rocketed Maj. Charles Yeager to a speed of Mach 2.5.

• Faster than any military prototype had ever flown, North American's YF-100 Super Sabre slammed through sonic speed and into the supersonic range under the guidance of senior engineering test pilot George Welch.

These tremendous speed strides, made possible by teams of industry, military and government pilots and technicians, have highlighted these factors underlying aircraft research and development today.

• **Drag reduction** is more important than ever. Very small changes in drag can be responsible for speed changes measured in hundreds of miles per hour.

• **Flight technique** can make the difference. The Douglas Skyrocket reached Mach 1.86 under the capable hands of Bill Bridgeman during the company's phase of the flight test program. After long study and minute planning of an optimum flight path and technique by a flight test team, NACA's Scott Crossfield took the same Skyrocket, unchanged, to Mach 2.01.

• **Windtunnel tests** can lead directly to tangible hardware. One big industry complaint in the past has been that NACA did nice basic work, but as for design data it left something to be desired. Now, North American's F-100 design owes its inboard ailerons, inlet lip shape and low positioned tail to recent hours of windtunnel time at the National Advisory Committee for Aeronautics.

These are credits on the aerodynamic ledger.

Problems

The debit column still has too many items to suit most engineers and scientists who keep watching the trend of development in the U. S.

• **Lateral stability.** One of the big problems is that supersonic airplanes are running out of lateral stability. The reason is an aerodynamic fact. The slope of the lift curve decreases with increase in Mach number. This means that a given change in wing angle of attack produces a lot less lift at Mach 3 than it does at Mach 1.3. It's this wing lift—applied differentially with ailerons or by dihedral effect—that makes an airplane controllable or stable in roll. If that lift is not available, you find yourself in the wild predicament that Bridgeman experienced in Skyrocket flights when a wing dropped in supersonic flight and he couldn't pick it up with the ailerons, couldn't turn, couldn't recover. He finally recovered by using full tab deflections.

• **Noise.** Another problem. What can be done about noise? This single question promises to cost more in time and money than many of the knotty problems of the past. It seems to be impossible to go fast, or to produce great amounts of power from moving air, without making an awful racket.

Military and civil aircraft alike are going to be increasingly noisy about their business, and the prospect of a jet transport in full cry over apartment roofs on Long Island has appalled civic authorities.

Something has to be done. The plain fact is that right now, nobody knows what to do. Further, nobody seems to know in which direction to go in order to find something to do.

So there are problems. If you want to talk aeronautical problems, the people to talk to are the scientists and engineers of the National Advisory Committee for Aeronautics.

NACA

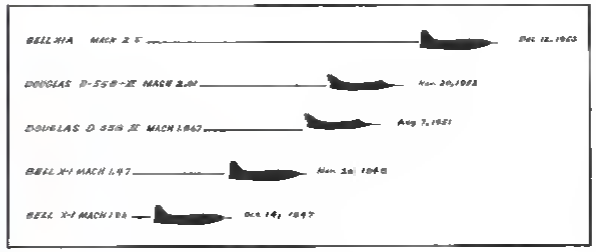
Established by act of Congress in 1915, NACA has almost sole control over aeronautical research and experiments in this country. Their job:

• "... To supervise and direct the scientific study of the problems of flight with a view to their practical solution."

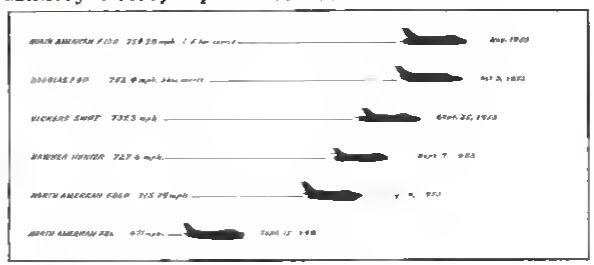
• ". . . To direct and conduct research and experiments in aeronautics."

Today one big trend in NACA's laboratories is the integration of the airplane and its avionics. Willy-nilly, NACA is getting drawn into the systems business. This was inevitable, be-

Research aircraft speed marks



Military aircraft speed records



■ ENGINEERING

cause airplanes themselves have become part of systems. It was careful consideration from a systems viewpoint that enabled NACA planners to get more out of the Skyrocket when nobody felt there was any more to get.

With the increase of systems study, the importance of the engineering test pilot increases. NACA's pilot staff has always accented the ability to do much more than horse the controls around.

The old-line test pilot came back from a flight and reported the effect. Today's engineering test pilots report the cause as well as the effect.

▶ **Engine Integration**—More than ever before, the engine of any airplane has to be considered as part of a flow system that begins to intercept air well ahead of the airplane, gulps it in huge quantities and exhausts it rapidly downstream. Every inch of the way, the moving air is doing something to the airplane or engine, and it is almost impossible to separate one effect from the other.

Part of NACA's powerplant work is combustion experiments; the results will help improve high-altitude performance of our engines during the next few years.

Another area where much remains to be done is in afterburner design. NACA regards the design of afterburners as an empirical task. Afterburner noise has another aspect in addition to its ear-shattering qualities; it is destructive to the afterburner.

There are two kinds of this noise, rumble (which is motion of the flame front amplified by the geometry of the tailpipe) and screeching. It's the latter that tears the guts out of an after burner, and one of NACA's big programs now is aimed at understanding the screech and doing something about it.

▶ **Configuration Studies** — Generally NACA doesn't test specific design configurations. It inclines toward stability studies of a delta wing, not the F-102 layout; it measures deflections of a swept wing, not the B-52 panels.

But NACA influence makes itself felt in airplane design. There are the three cases quoted for the North American F-100—intake lip shape, inboard ailerons and low horizontal tail.

Wing trickery in the form of leading edge extensions, fences, flaps and slots have come out of tunnel tests at Langley and Ames.

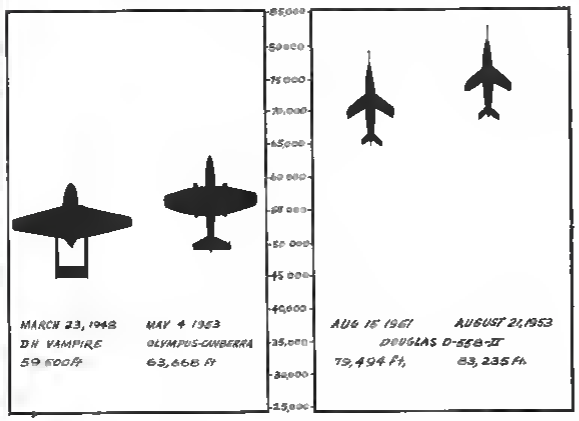
One layout, which was evolved with the low horizontal tail as an answer to stability problems at high speeds, places the engine farther aft and lower than is common now. So far no designers have picked this one up, but it's a safe bet that it won't be long now.

▶ **Noise Studies**—NACA scientists are vitally concerned with the noise problem. They got into it when they first started operating wind tunnels near inhabited areas, and they've been in the heart of the problem ever since.

Today there are several spearheads leading the attack on the noise problem. Lewis laboratory scientists are working with empirical approaches, they drew the assignment because they promised to have a fresh approach. These men formerly worked on aircraft crash fire studies; none of them previously had anything to do with either crash or fire studies. Their approach was fresh, their contributions huge.

Massachusetts Institute of Technology and its western counterpart, Cali-

Altitude marks, military and research



forma Institute of Technology, have contracts from NACA for analysis of sound. At the other extreme, NACA is paying for opinion sampling of noise levels found in everyday life. NACA believe that if it can find out what kinds of noise are objectionable and why, it at least will have begun to define the problem.

▶ **Other Fields**—A look through the NACA's annual report—which is an unclassified summary of reports issued during the year—shows unusual variety in the number and kinds of research studies.

In tests of maximum lift coefficients, tunnels run at a speed which a decade ago was maximum speed for lots of airplanes. Now it is the landing speed for some.

Minimized propeller noise has been added as a parameter to the traditional form of propeller selection charts. You can select a prop for transport airplanes up to a flight Mach number of 0.8 and for any engine between 1,000 and 10,000 hp.

There is emphasis on fuel development to increase performance of the airplane by virtue of the chemical properties of the fuel.

Fuel sloshing in wing tanks can be a help in reducing flutter or buffet, if you can count on having the fuel there all the time. How much help will the fuel give? NACA has started to find out.

Aerodynamic heating may be a blessing in disguise in some limited cases. For instance, it can keep a wing from icing. There are drawbacks. Liquid water will run back and freeze anyway. So NACA has a technical note presenting a quick method for calculating the icing limit at altitudes up to 45,000 ft. and speeds to Mach 1.8.

▶ **Research Takes 7,000**—The future paths of aeronautical progress are charted by the 7,000 technical and administrative people who make up the NACA, and populate its Washington headquarters and three main facilities.

• **Lewis Flight Propulsion Laboratory, Cleveland.** Here the entire spectrum of flight propulsion is painted in high-altitude test cells and windtunnels, on static test stands and in shops.

• **Ames Aeronautical Laboratory,** Moffett Field, Calif. Aerodynamic research is the job here. The world's largest windtunnel and some of the world's fastest share the acreage.

• **Langley Aeronautical Laboratory,** Langley Field, Va. This is the "general problem" lab, where aerodynamics and structures, hydrodynamics and design ideas are the order of the day.

Then there are two NACA sub-stations of science. At Wallops Island,

off the Virginia coast, rocket propelled models scream skyward over the Atlantic in highspeed tests of wing shapes, telemetry equipment, stability and control parameters

At the Air Force Flight Test Center, Edwards AFB, Calif, the NACA has its hangar and taxiway and flight crews

There are research subcontracts that NACA lets out to specialized groups across the country to tackle some phase of work especially suited to their talents Among them Massachusetts Institute of Technology, California Institute of Technology, Battelle Memorial Institute, Johns Hopkins University, the National Bureau of Standards

In 1953, the Committee used about $58 million of its appropriated funds, carrying over an unobligated balance of about $8 million The bulk of this money—about $48 5 million—went directly into salaries and expenses of the laboratories, the substations and the subcontracts

▶Unitary Plan—First of the NACA tunnels to be operated under the so called Unitary Plan will start testing this year. Planning for the Unitary scheme began in 1944 and stretched into 1947 as representatives of government and industry met with those of NACA They hammered out a proposal for a coordinated plan for windtunnel procurement

The plan was considered, reconsidered, cut down, and finally legalized in Public Law 415 of the 81st Congress It had started at a cost level of more than $2 billion, comparable to the first atomic bomb costs It was pared down finally to a group of appropriations totaling about $500 million

When the planning began, maximum speed of airplanes was a little over 500 mph Next year when the first tunnel starts moving air, the speed record will stand at more than three times that figure

The NACA annual report has this to say about the problems tomorrow "The lack of mathematical methods for predicting theoretically aerodynamic behavior in the speed ranges of tomorrow's aircraft means that this kind of information must be obtained through use of experimental techniques, the most satisfactory of which requires use of the large wind tunnel of the kind being provided under the Unitary Windtunnel Plan

"Before the end of 1954, the first of the Unitary Plan supersonic wind tunnels will be in fruitful use as a tool in the hands of America's producers of supersonic aircraft and missiles The planning of a decade ago began not a moment too soon"

U. S. RESEARCH PLANE FLEET (reading clockwise from lower left) Bell X-1A, Douglas D-558-I, Convair XF-92A, Bell X-5, Douglas D-558-II, Northrop X-4. Douglas X-3 is in center of group. Specifications of these airplanes are in table below.

U. S. RESEARCH AIRCRAFT

Manufacturer and Address	Designation	Seats	Number, make, model and power of engine	Maximum speed (mph)	At altitude (ft.)	Gross weight (lb.)	Span	Length	Height	Remarks
Bell Aircraft Corp. *Buffalo, N. Y.*	X-1	1	1 RMI-6000-C-4 @ 6 000 lb. t	1,000	80 000	13 000	28'	34' 6"	10' 10"	First to exceed Mach 1. 10-14-47
	X-1A[1]	1	1 RMI XLR-11 RM-5 @ 8,000 lb. t	1,600	70 000	16 000	28	35' 7"	10' 9"	Turbine driven fuel pump
	X-2	1	1 C-W Rocket	2,000	100,000					Stainless-steel swept wings, K-Monel fuselage tail
	X-5	1	1 All. J35-A-17 @ 4,900 lb. t			9 000	32' 0"[1]	35' 0"	12' 2"	Variable-sweep wings. Transonic trials.
Consolidated Vultee Aircraft Corp. *San Diego, Calif.*	XF-92A	1	1 All. J33-A-30 @ 9,200 lb. t.+			15 000	31' 3"	42' 6"	17' 8"	Delta-wing research.
Douglas Aircraft Co. *El Segundo, Calif.*	D-558-I	1	1 All. J35-A-11 @ 6,000[3] lb. t	650+		10,000[3]	25	35' 1"	12' 2"	Set record of 650 6 mph 8-26-47
	D-558-II	1	1 RMI Rocket[3] @ 6,000 lb. t	1 2384			25'	40' 5"	11' 6"	Wings swept 35 deg.
	X-3	1	2 West. J34-WE-17 @ 4,600 lb. t.[5]	—		27,000	22' 8"	66' 9"		High-speed, altitude research.
Northrop Aircraft, Inc. *Hawthorne, Calif.*	X-4	1	2 West. J30 @ 1 600 lb. t		10 000	7 000[6]	26' 10"	23' 4"	14' 10"	Semi-tailless sweptwing. High-transonic tests

' — Approximate
All — Allison
C-W — Curtiss-Wright
RMI — Reaction Motors, Inc.
West — Westinghouse
Lb. t. — Pounds thrust

[1]Other versions X-1B, X-1D. Each will collect aerodic data in supersonic regime. X-1D destroyed during test program 8-23-51.
Wings fully forward. With wings swept, span is 23 ft. 4 in.
[3]Originally fitted also with one Westinghouse J34 to provide takeoff power and climb to altitude. Turbojet later removed from at least one of three Skyrockets to make room for more rocket fuel. Plane then carried aloft in belly of Boeing B-29-TS Superfortress.
[4]This speed achieved during course of high speed, high-altitude trials.
[5]Originally 2 Westinghouse J46 jets of approximately 7 000 lb. thrust each scheduled for X-3.

U. S. Military Aircraft

Manufacturer and Address	Designation Model	Designation Name	Primary Mission	Number of crew	Powerplants: Number, make, model and max. takeoff power of engine	Max. speed (mph.)	Weight: Gross weight (lb.)	Dimensions: Overall span	Overall length	Overall height	Wing area (sq. ft.) including ailerons	Basic Ordnance
Beech Aircraft Corp *Wichita 1 Kan.*	T-34A	Mentor	Trainer	3	1 Con. O470-13 @ 225 hp.	180	2 900	32' 11"	25' 10"	9' 7"	177.2	None
Boeing Airplane Co *Seattle 14, Wash.*	B-47E[1]	Stratojet	Med. Bomb.	3	6 GE J47 @ 5,800 lb t.	600*	185 000	116'	106' 6"	27' 11"		2 x 20-mm
	B-52A	Stratofortress	Heavy Bomb		8 P&W J57-P-3 @ 10,000 lb.t.	600+	350 000+	185'	153'	48'		Classified
Cessna Aircraft Co *Wichita, Kan.*	L-19A	Bird Dog	Liaison	2	1 Co. O470-11 @ 213 hp.	150	2 100	36'	25'	7' 6"	174	None
	XT-37		Trainer	2	2 Con. Marboret 352 @ 300 lb.t.	409*	5 600*	38'	27' 1"	9' 10"		None
Consolidated Vultee Aircraft Corp. *San Diego Calif* *Ft. Worth, Tex.*	B-58[2]		Heavy Bomb.	16	6 P&W R4360-53 @ 3,800 hp.[3]	618+	400,000+	230'	162'	46' 9"	4 772	16 x 20-mm. Missiles
	F-102[3]		Fighter	1	1 P&W J57 P 11 @ 10 000 lb	750+						Classified
	T-29D		Trainer	4	2 P&W R2800-99W @ 2,500 hp.	361	46 000+	91' 0"	74' 5"	27' 3"	817	None
	XF2Y-1	Sea Dart	Fighter	1	2 Westi. J34 @ 3,500 lb.t.	700*						Classified
	R3Y 1	Tradewind	Transport	11	4 All T40 @ 5,500 eshp.	350+	190 000+	149'	142' 6"	61' 8"		
Douglas Aircraft Co., Inc. *El Segundo, Calif* *Long Beach, Calif*	B-66B		Attack	3	2 All. J71-A-6 @ 10,000 lb.t.	600+						Classified
	AD-6	Skyraider	Attack	1-3	1 Wr R3350-26WA @ 3,700 hp.	300+	18 000	50'	39' 10½"	15' 8"	400	4 x 20-mm.
	A3D-1		Attack	6	2 P&W J57 @ 10,000 lb.t.	650+	70 000*					Classified
	XA4D-1		Attack		Wr J65							Classified
	F4D-1[4]	Skyray	Fighter	1	1 P&W J57 @ 15,000 lb.t.	750+		38' 0"	50'[5]			Classified
Fletcher Aviation Corp *Pasadena, Calif*	FD-35[2]	Defender	Attack	1	1 Con E225-4 @ 250 hp.	197	2 500	30'	30' 11"	6' 3"	150	2 x .30-cal.
Grumman Aircraft Engineering Corp *Bethpage, L. I., N. Y*	SA-16A	Albatross	Rescue	4-6	2 Wr.R1820-78 @ 1,425 hp.	247	34,000	80'	60' 8"	24' 3"	885	None
	F9F-9[6]	Cougar	Fighter	1	1 P&W J48 @ 7 000 lb t.[6]	650+						Classified
	S2F-1		ASW	4	2 Wr R1820-76 @ 1 450 hp.							Classified
Lockheed Aircraft Corp. *Burbank Calif*	F-94C	Starfire	AW Fighter	2	1 P&W J48-P-5 @ 9,250 lb.t.+	600+	30 000*	37' 0"	41' 2"	13' 7"		48 x 2.75-in. rockets
	XF-104		Fighter	1	1 Turbojet							
	T-33A		Trainer	2	1 All J33-A-35 @ 5,200 lb.t.+	600*	15 000	38' 10½"	37' 6"	11' 5"	237.6	6 x .50-cal.
	P2V 7	Neptune	Patrol	8*	2 Wr R3350 @ 3 750 hp.[7]	3000+						
	P2V-6	Neptune	Patrol		2 Wr R3350 @ 3 250 hp	300*		104'6	79'6	29'	1,000	Classified
	WV-2[8]		Picket		4 Wr R3350-34 @ 3,850 hp.	325*	120 000	130'	116'	25'9	1,650	None
	T-33B[9]		Trainer	2	1 All J33-A 16A @ 7,200 lb t.	500*		42'6	38'9	13'9		
Glenn L. Martin Co. *Baltimore 3 Md.*	B-57A		Intruder	2	2 Wr J65 @ 7,200 lb.t.+	600+	50 000+	64	65' 6"	15' 7"	960	Classified
	P5M-2[6]	Marlin	Patrol	7	2 Wr R3350-32W @ 3,400 hp.		74 000*	118'	99'	61' 7"		
	XP6M-1	Sea Master	Patrol		Turbojet							Classified
McDonnell Aircraft Corp. *St Louis, Mo*	XF-101	Voodoo	Fighter	1	2 P&W J57 P 16 @ 10 000 lb.t.	700+						Classified
	F3H-1N[10]	Demon	Fighter	1	1 Westi. J40-WE-8 @ 10,000 lb.t.	750+		39' 4"	50'[6]	14'6		4 x 20-mm.
North American Aviation, Inc. *Los Angeles Calif*	F-86D	Sabre	AW Fighter	1	1 GE J47-GE-17 @ 5,800 lb t.	700	18 000	37' 1"	40' 2"	15'		24 x 2.75-in. rockets
	F-86F	Sabre	Fighter	1	1 GE J47-GE-27 @ 5,200 lb.t.+	650+	20 000*	37' 1"	37' 7"	14' 7"		6 x .50-cal.
	F-86H	Sabre	Fighter	1	1 GE J73-GE-3 @ 8 000 lb.t.	650*	16 000	37'	38'	15'		4 x .50-cal.
	F-100A[11]	Super Sabre	Fighter	1	1 P&W J57 P-7 @ 16,000 lb.t.	750+		38'	46'	15'		Rockets
	T-6G	Texan	Trainer	3	1 P&W R1340-AN-1 @ 600 hp.	212	5 280	42'	29' 2"	11'	255	
	T-28B		Trainer	3	1 Wr R1820 @ 1 425 hp.	343	8 013	40' 7"	32'	12' 6"	271	
	TF-86F	Sabre	Trainer	2	1 GE J47-GE-27 @ 5,800 lb.t.	650	17 000*	37'	42'	14'		2 x .50-cal
	AJ-2	Savage	Attack	6	2 P&W R2800-48 hp @ 2 400[12]	423[13]		71'	65'	20'		Classified
	FJ-2	Fury	Fighter	1	1 GE J47-GE-2 @ 5,600 lb.t.	650	18 000	37'	37'	14'		4 x 20-mm.
	FJ-3	Fury	Fighter	1	1 Wr J65 @ 7,200 lb.t.+	700+						4 x 20-mm.
	FJ-4	Fury	Fighter	1	1 Wr J65 @ 7,220 lb.t.	700*						4 x 20-mm
Northrop Aircraft, Inc. *Hawthorne, Calif*	F-89D	Scorpion	AW Fighter	2	2 All. J35 @ 8 200 lb.t.+	600*	40 000*	59' 2"	53' 4"	17' 7"	600*	104 2.75-in. rockets
Republic Aviation Corp *Farmingdale L I., N Y*	F-84F[14]	Thunderstreak	Fighter	1	1 Wr J65 @ 7,200 lb t.+	600+	25 000	34'	43'	14'		6 x .50-cal.
	XF-91		Fighter	1	1 GE J47-GE-3 @ 5 200 lb.t.[14a]	700+		31'	40' 8"	15'		Classified
	XF-103		Fighter	1	1 Wr J67 @ 15,000 lb t.	750+						Classified
	XF-105		Fighter	1	All. J71 A-7 @ 10,000 lb.t.	650+						Classified
Ryan Aeronautical Co *San Diego, Calif*	72		Trainer	2	1 Lyc. GO435-C2 @ 260 hp	178	2 800	37 8"	25' 4"	7' 11"	162.2	
Temco Aircraft Corp *Dallas 2 Tex*	33	Pinto	Trainer	2	1 Con. O470-13 @ 225 hp.	193	2 500	31 9½"	25' 5"	9' 10"	184	
Chance Vought Aircraft, Inc *Dallas, Tex.*	F7U-3	Cutlass	Fighter	1	2 Westi. J46 @ 7 000 lb t.	700+						Classified
	A2U 1	Cutlass	Attack	1	2 Westi. J46 @ 6,000 lbt	650+						
	F8U 1		Fighter	1	1 P&W J57 (afterburner)							

0 — Approximate.
All — Allison
AW — All weather
Con. — Continental
Fr. — Franklin (Aircooled Motors)
GE — General Electric
P&W — Pratt & Whitney Aircraft.
Westi. — Westinghouse.
Wr — Wright.

[1] Plan four GE J47 turbojets of approximately 5,200 lb thrust each paired in underwing pods.
[2] Reconnaissance version is RB-47E. Strategic can also built by Douglas Aircraft Co., Tulsa, Okla., Lockheed Aircraft Corp., Marietta, Ga
[3] Later model will have new wing and more powerful Wright J67 turbojet
[4] Douglas XF4D-1 with Westinghouse J46 set 3-km. speed record of 753.4 mph October 1953.
[5] F9F-7 is similar but has Allison J33-A-12
[6] Plus 1 Westinghouse J34 @ 3,400 lb thrust under each wing
[7] USAF counterpart is RC-121C
[8] Similar to T-33A but with automatic wing slats, new nose cockpit, jet Has tail-mounted drag chute. Developed with Lockheed funds.
[9] Similar to P5M-1 but with T-tail and low chine hull
[10] Later F3H production models powered with Allison J71
[11] Set 15-km speed record of 754.98 mph. November 1953.
[12] Fighter versions have nose intake Photo RF-84F carries cameras in "solid" nose and has jet intakes in wing roots. Ordnance 4 x .50-cal guns. Thunderstreak range can be extended by air-to-air fueling or using parasite technique with Convair B-36 as "mother"
[13] Plus Reaction Motors XLR-11-RM-6 rocket motor unit of approximately 6,000 lb thrust in tail
[14] Plan one Allison J33 in rear fuselage.
[14a] Similar to P5M-1 but with T-tail and low chine hull

U. S. Personal and Business Aircraft

Manufacturer and Address	Designation	Seats	Powerplants: Number, make, model and max. takeoff power of engine	Performance: Maximum speed @ gross wt. (mph.)	Cruise speed (mph.)	Takeoff distance (ft.) to clear 50-ft. obstacle @ gross wt., no wind @ SL	Landing distance (ft.) over 50-ft. obstacle @ gross wt., no wind @ SL	Initial rate of climb (fpm.) @ gross wt. @ SL	Service ceiling (ft.) @ gross wt.	Max. still air range (mi.) @ gross weight, without auxiliary fuel	Fuel: Normal fuel capacity (gal.)	Weights: Gross weight (lb.)	Empty weight (lb.)	Dimensions: Overall span	Overall length	Overall height	Wing area including ailerons (sq ft.)	Price: Standard model price (FAF)
Aerocar, Inc., *Longview, Wash.*	1 (Flying Auto)	2	1 Lyc. O290-D2 @ 135 hp.	120+	105+	1 225*	750*	500+	12 000	350	24	1 800	1 400	34	21 2"	7 2"	190	$25 000
Aero Design & Engineering Corp., *Bethany, Okla.*	Aero Commander 520	5-7	2 Lyc. GO435-C2B @ 260 hp	211	197	550	900	1,700	24 000	1 160	150	5 500	3 800	44'	34 2½"	14 4½"	242.5	$66,500
Aero-Flight Aircraft Corp, *Long Beach, Calif*	Streak 160	2	1 Fr. @ 165 hp	229	210	429	—	1 900	25,500	1 000	40	1 600	1 045	25 3"	22 4"	3 3"		—
Anderson, Greenwood & Co, *Bellaire, Tex.*	AG 14	2	1 Con. C90-12FP @ 90 hp	100+	110			700+	10 000+	450	23	1 400	850	34	22	8'	120	$4 415
Baumann Aircraft Corp, *Pacoima, Calif*	Brigadier B-290	5	2 Con. C145 @ 145 hp	150	170	1 500*	800*	1,200*	18 000	730	75*	3 800*	2 230*	41'	27 5"	10 *	213	
Beech Aircraft Corp., *Wichita, Kan*	D18S Twin Beech	5	2 P&W R985-B5 @ 450 hp.	230	211	1 760	1 480	1 100	26 800	855	206	8 750	5 770	47 8"	34 3"	11 8"	349	$87 050
	E18S Twin Beech		2 P&W R985-AN-14B @ 450 hp.	234		2 060	1 370	1 250	23 300	1 455		9 300	5 150					$100 000[2]
	E35 Bonanza[1]	4	1 Con. E225-8 @ 225 hp.	184	181	1 000	707	1 300	19 500	850	39	2 725	1 675	32 10	25 2	6 6½	177.6	$18 990
	B50 Twin Bonanza	6	2 Lyc. GO435-C2 @ 260 hp.	205	185	1 258	1 375	1 450	20 500	1 085	124	6 000	3 910	45 3½"	31	11' 4	277	$60 530
Beecraft Associates, Inc., *San Diego, Calif*	Wee Bee	1	1 Kiek. O45-35 @ 28 hp.	82	72	700	500	350	6 500	75	3	410	210	18	11 2"	5	44	
	Honey Bee	1	1 Con. A65-8 @ 65 hp.	120	110	500	400	1 000	16 500	240	8	860	610	23	16 10"	7 5"	88	
	Queen Bee	4	1 Lyc. O340 @ 150 hp	175	160	1 000	700	1 000	18 000	700	30	180	1 100	32 10"	22 1"	8 5"	160	
Bellanca Aircraft Corp., *New Castle, Del.*	14-15 Cruisemaster	4	1 Lyc. O435-A @ 190 hp	—	190	—	—	1,500	20,500	800	54	2 500	1 600	34 2"	23	6 2½"	161	
Callair, *Afton, Wy*	A-2	2-3	1 Lyc. O290-D2 @ 140 hp.	120	105			1 000	17 500	600	25	1 850	875	35 8½'	23 8½"	7	160	$6 425
	[illegible] Super Cadet	2	1 Lyc. O290-D2 @ 135 hp.	125	115			1 200	17 500	600	40	1 800	1 000	35' 0"	24'	7		$6 320
Central Lamson Corp, *Seattle, Wash.*	Air Tractor L-101	1	1 P&W R985 @ 450 hp.	120	105	1 120	1 000	810		340	65	5,500	2 961	42' 7"	28	11 0"	300	
Cessna Aircraft Co, *Wichita, Kan.*	170	4	1 Con. C145 @ 145 hp	140	120			690	15 500	540	42	2 200	1 205	36'	25	6 7"	175	$8 295
	180	4	1 Con. O470-A @ 225 hp.	160	150			1 150	21 500	675	60	2 550	1 480	36	26	7 6"	175	$12 950
	195 LC-126A	5	1 Jacobs R755 @ 300 hp	150	135			1 200	18 300	750	80	3 350	2 030	36 2"	27 4"	7 2"	216	$24 700
	310	5	2 Con. O470-B @ 240 hp.	220	205			1 700	20 000	1 000	100[3]	4 600	2 850	35' 1"	27 1"	10 2"	175	$46 950
Colonial Aircraft Corp., *Huntington, L. I., N. Y*	C-1 Skimmer	3	1 Lyc. O290-D @ 130 hp.	125	115			700		700	40	1 800	1 500	24	23 0"	8' 10"	150	$12,500
Helio Aircraft Corp., *Norwood, Mass*	H-391 Courier YL-24	4	1 Lyc. GO435-C2B @ 260 hp.		137	500	900	1 100	27,000	900	60	2,800	1 000	36	30	8 3½'	231	$24 500
Lanier Aircraft Corp, *Marlton, N. J*	Paraplane 8	2	1 Con. C90 @ 90 hp.	124	100	300*	350*	1,265						20' 5"	22	6 4"	107	
Meyers Aircraft Co, *Tecumseh, Mich*	145	2	1 Con. C145-2H @ 145 hp	163	150	900	875	850	15 500	600	32	1 616	1 250	30'	21 10"	6	155	$9 750
	200	4	1 Con. O470-E @ 225 hp.	190	182			1 600	18 500	700	44	2 600	1 625	30' 4"	23 8½'	7'	190	$16 900
Mooney Aircraft, Inc., *Kerrville, Tex.*	18LA Mite	1	1 Lyc. O145-B2 @ 65 hp	140*	125			1,200	16,400		11	780	520	26' 10½'	17' 7"	6 2½'	55	
	20	4	1 Con. C145-2H @ 145 hp.	170	161			1 200	21 500	718		2 000	1 046	35	23 2½'	8' 3½'	166	
Piper Aircraft Corp., *Lock Haven, Pa.*	PA-18 Super Cub	2	1 Lyc. O290-D2 @ 135 hp.	127	112	500	800	1 000	20 900	500	36	1 500	895	35' 3"	22' 5"	6' 7"	178.5	$5 995
	PA-18 95 Super Cub	2	1 Con. C90 @ 90 hp.	110	100	932	800	624	13 500	350	18	1,500	800	35' 3"	22 4"	6 7"	178.5	$4 195
	PA-18-A 135	1-2	1 Lyc. O290-D2 @ 135 hp.	125	110	810	600	1 000	19 500	500	36	1 500	930	35' 2"	22' 4"	6 7"	178.5	$7 195
	PA-20 Pacer	4	1 Lyc. O290-D2 @ 135 hp.	139	125			800	15 500	540	36	1 950	1 000	29 3"	20 4"	6 7"	147.5	$8 275
	PA-22 Tri-Pacer	4	1 Lyc. O290-D2 @ 135 hp.	137	123			800	15 500	580	36	1 950	1 085	29' 3"	20' 4"	8' 6"	147.5	$8 475
	PA-23 Apache	4	2 Lyc. O320 @ 150 hp.	180	167	900	970	1 350	20 500	850	72	3 500	2 163	37	27 2"	9 6"	204.2	$32 500
Rawdon Bros. Aircraft, Inc., *Wichita, Kan.*	T-1	2	1 Lyc. O320 @ 150 hp.	145	130	600	900	800	15 000	600	44	1 800	1 275	33 4"	24 6"	7' 5"	167	
Stits Aircraft, *P. O. Box 3084, Riverside, Calif*	Junior	1	1 Con. C85 @ 87 hp.	180	165	600	1,500	1 800		75	4½	584	398	8' 10"	11 4"	4 3"	38	
	Skybaby	1	1 Con. C85 @ 112 hp.	215	180	400	800	1 600		100	5	650	452	7 2"	9 10"	5'	30.5	
	Playboy SA3A[4]	1	1 Con. C85-8 @ 87 hp	170	135	350	600	1 500	14 000	450	10	—	540	20' 0"	17' 4"	5 3"	90	$2 500
Streak Aero Corp, *P. O. Box 181, Hollydale, Calif*	Streak 225[5]	2	1 Lyc. @ 225 hp.	236	225	450		2 210	27 000	1 200	60	1 964	1 170	25 3"	22' 5"	8 1"		
Taylorcraft, Inc., *Conway, Pa.*	BC-12-D De Luxe	2	1 Con. C65 @ 65 hp.	105	98	350	710	800	15 000	400	25	1 200	730	36 0"	21	6' 0"	183.7	$3 000
	15AG Topper	1	1 Con. @ 225 hp.	131	122	1 250	560	825	17 300	400	42	3 015	1,900	35 5"	24'	7 1½'	166.3	[illegible]
Temco Aircraft Corp., *Dallas, Tex.*	Twin Navion[6]	4	2 Lyc. O320 @ 160 hp	180	175	700	650	1 400	20 000	800	60	3,350	2 600	33 4½'	27' 2"	8' 8½'	178.8	$38 500[6]

* — Approximate.
Con. — Continental
Fr. — Franklin (Aircooled Motors).
Hp. — Horsepower
Kiek — Kiekhaefer
Lyc. — Lycoming

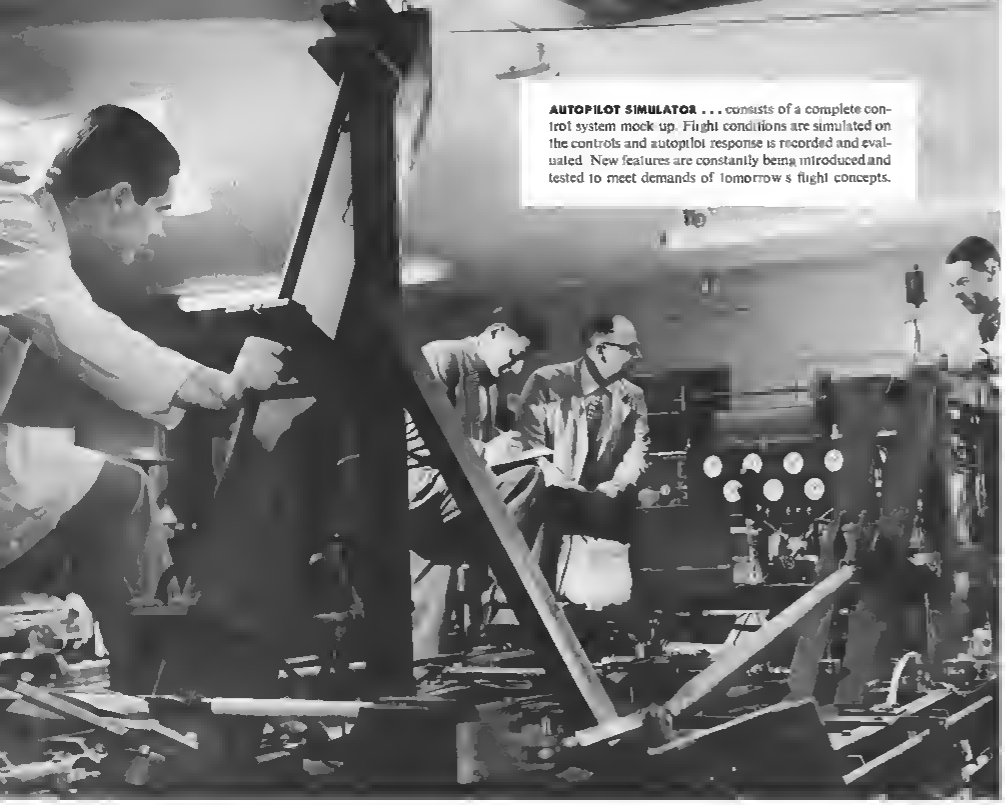
P&W — Pratt & Whitney Aircraft.
SL — Sea Level.
[1] Also available with Con E185-11 @ 205 hp. This version costs $18,860.
[2] De luxe model.
[3] All fuel in tiptanks.

[4] Experimental model which is being developed to two-placer with folding wings.
[5] Built under license from Aero-Flight Aircraft Corp maker of Streak 160.
[6] Plus original Ryan or North American-built single-engine airframe.

U. S. Civil and Military Transport Aircraft

Manufacturer and Address	Designation	Seats: Crew	Seats: Passengers	Power Plants: Number, make, model and max. takeoff power of engine	Performance: Max. speed (mph.)	Cruise speed (mph.)	Takeoff distance (ft.) over 50 ft. obstacle @ gross wt. no wind @ SL	Landing distance (ft.) over @ ft. obstacle @ max. allowable landing gross wt. no wind @ SL	Initial rate of climb (fpm) @ max. gross wt. @ SL	Max. still air range (mi.)	Fuel: Normal fuel capacity (gal.)	Weights: Max. gross weight (lb.)	Empty weight (lb.)	Dimensions: Overall span	Overall length	Maximum height	Wing area including ailerons (sq ft.)
Boeing Airplane Co	707¹		100	4 P&W J57 @ 11,000 lb. thrust*	600+	580						190 000	92,120	130'	127' 10"	38' 5"	3,000
Seattle 14 Wash.	KC-97G Stratofreighter	5	80	4 P&W R4360-59 @ 3,500 hp	375	300	5 500	4,000	—	4,300	7,700	175 000	—	141' 3"	110' 4"	38' 3"	1,720
Consolidated Vultee Aircraft Corp	340 Convair-Liner	3-4	44	2 P&W R2800-CB-16 @ 2,400 hp.	316	284	4 675	4 500	1 320	1 850	1 730	47,000	29 486	105' 4"	79' 2"	28' 2"	920
	Turbo-Liner			2 All. T-501 @ 2 750 eshp	350+	312	3,150		1 940	1 960	1 550	41,800*		91' 9"	74' 8"	27'*	817
San Diego Calif	C-131A Samaritan	4		2 P&W R2800-52 @ 2,500 hp.	330						1 550	40,000+	28 300	91' 9"	74' 8"	27' 3"	817
Douglas Aircraft Co., Inc.	DC-6A Liftmaster	3	6	4 P&W R2800-CB-17 @ 2,500 hp.	371	315	4,500	3,100	1 600	4,807	3,992	107,000	51 318	117' 6"	100' 6"	28' 5½"	1,463
	DC-6B	5	66	4 P&W R2800-CB-17 @ 2,500 hp.	371	315	5,380	4,995	1 050	3,720	3,992	100 000	55 357	117' 6"	105' 6"	28' 5"	1,463
Santa Monica, Calif.	DC-6B	7	54-92	4 P&W R2800-CB-17 @ 2,500 hp.	370	318	5 610	3,350	1 000	4,370	5,512	107 000	58 340	117' 6"	108' 6"	28' 6"	1 463
	DC-7	3	60-90	4 Wr. 972TC18DA4 @ 3,250 hp.	400	360	5,350	5 970	1 130	4,930	5 200	125 000	68 093	117' 6"	108' 11"	28' 7"	1 463
	C-124C Globemaster 2	8	200	4 P&W R4360-63A @ 3,800 hp.							11 058	185 000	101 032	174' 1"	130'	48' 3"	2 511
	R4D-8	3	33	2 Wr. R1820-80 @ 1,475 hp.	270	234	2,330	1,580	1 350	4,000	1 004	31 000	19 800	90'	67' 8¾"	18' 3"	987
Fairchild Aircraft Div	M-186B	3-4	44	2 Wr TJ32C3 @ 12,000 lb.t.		570				1,500		78,770		100'	88' 7"	31'	2,000
Fairchild Engine & Airplane Corp	C-119G Packet	5	62	2 Wr R3350-85 @ 3 500 hp	260+	200				2 300	2,700¹	74 400		109' 3"	86' 5"	26' 6"	
	C-119H Packet	3	62	2 Wr R3350-85 @ 3 500 hp	250+	185				3 250	2 614¹	85 000		148'	36' 5"	32'	
Hagerstown, Md	XC-120 Pack Plane	3	62	2 P&W R4360 @ 3,500 hp	250+	170				3 100	2 738	70 700		109' 3"	88'	24' 10"	
	C-123B²	3	60+	2 P&W R2800-99W @ 2,300 hp.	243	200	3,080	1,050	1 220	3,050	1 462	54,000	30 000	110'	75' 3"	34' 1"	1 223
Lockheed Aircraft Corp.	1049C Super Constellation	5-11	47-99	4 Wr 972TC18DA1 @ 3 250 hp.	352	331	4 300	2 410	1,100	4 810	6,550	130 000	69 792	123	113' 7"	24' 9"	1 650
Burbank, Calif	1049D Super Constellation	3-7	5	4 Wr 972TC18DA1 @ 3,250 hp.	375	333	4 600			4 480	6 550	133 000		123	113' 7"	24' 9"	1 650
	1049E Super Constellation	5-11	47-99	4 Wr 972TC18DA1 @ 3,250 hp.	375	333	4 600	5 330	1,140	4 820	6 550	133 000	70 166	123'	113' 7"	24' 9"	1,650
	C-130A			4 All T56 @ 3,750 eshp.*										132'	98	38'	
	R7V-1³ RC-121C	8	106	4 Wr R3350-34 @ 3 250 hp.	400*	340	4 300*	3 400*	1 000*			130,000		123	116' 2"	24' 8"	1,654
Glenn L. Martin Co. *Baltimore, Md.*	4-0-4	5	40	2 P&W R2800-CB-16 @ 2 400 hp.	312	280	1 900	1,780	1 600	2 525	1 550	44 900	29,126	93' 3"	74' 7"	28' 5½"	864

* — Approximate.
All. — Allison.
P&W — Pratt & Whitney Aircraft.
Wr — Wright.
Eshp. — Equivalent shaft horsepower
Hp — Horsepower
Lb t. — Pounds thrust.
¹ Estimated data.
² Former Chase Aircraft Co. airplane to be produced by Fairchild
³ R7V-2 will have P&W T34 turboprops.

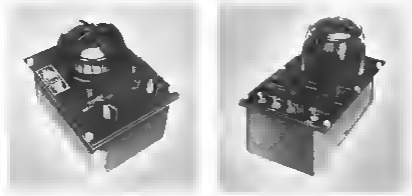


AUTOPILOT SIMULATOR . . . consists of a complete control system mock up. Flight conditions are simulated on the controls and autopilot response is recorded and evaluated. New features are constantly being introduced and tested to meet demands of tomorrow's flight concepts.

Only production automatic pilot to use rate gyros . . .

Modern, high-speed aircraft, because of aerodynamic requirements, often suffer from poorly damped natural oscillations—they are inherently unstable. The sensing elements which detect these oscillations and provide the "intelligence" to eliminate them is the rate gyroscope. By developing a rate gyro and applying it to the E-9 and W-3 systems, Westinghouse has elevated the automatic pilot to the vitally important tactical role of a completely automatic, integrated flight control system.

The rate gyro will not tumble, and provides instantaneous response to external disturbances and attitude changes. Using rate gyros in all three axes—roll, pitch, and yaw—Westinghouse rate automatic flight control systems can maneuver an aircraft quickly and smoothly, as well as provide "platform" stability.

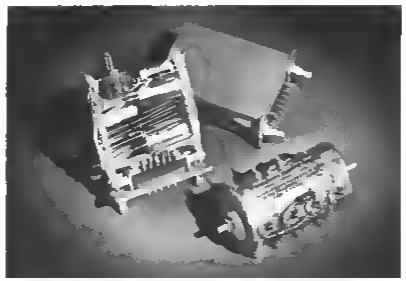


These are the pilot's consoles of the E-9 and W-3 Rate Automatic Pilots. Controls are human engineered to achieve simplicity of operation. The W-3A has provision for radar coupling and ILS tie-in, making the autopilot serve a vital new role in automatic flight control.

Mogomps improve reliability, decrease weight . . .

The MAGAMP (magnetic amplifier)—a Westinghouse exclusive—is used to make the rate automatic pilot a new standard of dependability. As simple and reliable as iron and copper, MAGAMPS are rugged replacements for vacuum tubes. MAGAMPS operate directly from the ac supply voltage and require no filament current, hence have a greatly reduced cooling requirement. Greater component life is inherent in the transformer-like construction of MAGAMPS. Wherever used, they give systems added value with their reliability and long life.

These features make the Westinghouse rate automatic pilot far more dependable. Maintenance requirements are reduced, circuitry is simplified and these full-time automatic flight control systems can be depended upon to perform under all types of operating conditions.



MAGAMPS and Potted Units are two refinements developed by Air Arm to give electronic systems exceptional reliability and ease of maintenance. MAGAMPS are a Westinghouse development using specially wound cores, printed circuits and Fosterite® impregnation to protect against all atmospheric conditions, and improve heat dissipation and dielectric properties.

• • •

Air Arm facilities now producing rate automatic pilots . . .

Rate automatic pilots are being produced in quantity at the Westinghouse Air Arm Plant. The W-3 system—now flying in an Air Force all-weather interceptor—includes an ILS (instrument landing system) tie-in for automatic, "hands-off" approach to a field in low visibility weather. Soon to come for the W-3 system is a radar tie-in, which means that the automatic pilot will take commands directly from the fire control system and automatically fly the interceptor on a computed intercept course . . . for what might be termed an automatic kill.

Airborne equipment must be as precise as a watch and as rugged as a steam roller. Fabricating such equipment and tailoring it to an airplane is not just a matter of taking measurements and cutting to a pattern—it requires real know-how and experience.

• • •

Today's answer for tomorrow's problem . . .

Experience has shown that in our business no problem ever stays solved. The requirement of building a better system is always with us. To meet the ever-increasing requirements of high-speed automatic flight, our development labs are at work, creating the advancements for tomorrow's flight systems. Thus, Air Arm is helping to bring Tomorrow's Aircraft . . . One Step Closer. Westinghouse Electric Corporation, Air Arm Division, Friendship International Airport, Baltimore, Md.

Component of Westinghouse Rate-Type Autopilot is shown here being bench tested. This is part of the Air Arm program which guarantees that every unit will meet rigorous military specifications. Ability to produce and qualify complete systems under one roof means more defense for the defense dollar.

THE SCOPE OF WESTINGHOUSE IN AVIATION

Jet Propulsion • Airborne Electronics • Aircraft Electrical Systems and Motors • Wind Tunnels to Plastics

YOU CAN BE SURE...IF IT'S

Westinghouse

U. S. Civil and Military Helicopters

Manufacturer and Address	Designation		Seats (including crew)	Powerplants: Number make model and max. takeoff power of engine	Performance: Maximum speed (mph.) @ SL	Performance: Initial rate of climb (fpm.) @ SL, fully loaded	Performance: Hovering ceiling (ft.) In ground effect	Performance: Normal still air range (mi.)	Fuel: Normal fuel capacity (gal.)	Weights: Max. allowable takeoff gross weight (lb.)	Weights: Empty weight (lb.)	Main Rotor: No. of rotors	Main Rotor: Blades per rotor	Main Rotor: Rotor diameter	Dimensions: Total rotor blade area (sq. ft.)	Dimensions: Max. length, blades unfolded	Dimensions: Fuselage maximum width	Dimensions: Overall height to top of rotor
American Helicopter Co. Inc. *Manhattan Beach Calif*		XH-26	1	1 AHC AJ-6.75* pulsejet	80				1.5 hr	700*	300	1	2					6'
Bell Aircraft Corp. **Helicopter Division** *Ft. Worth Tex.*	47G H 200	H-13G XHSL-1 XV-3*	3	1 Fr 6V4-200-C32 @ 200 hp. 1 P&W R2800 @ 1 900 hp	91	800	3 800	215	40	2 350	1 400	1 3	2 2	35' 1½"	83.3	47' 8½"	7' 6"	9' 8½"
Brantly Helicopter Corp. *% Penn Plastic Co* *Philadelphia, Pa.*	B-2		2	1 Lyc. @ 150 hp.				600+	24	1 250	741	1	3	23		17' 11"	3' 11"	8' 10"
Cessna Aircraft Co. *Helicopter Division* *Wichita, Kans.*	CH-1		4															
Convertawings, Inc. *Amityville, N. Y.*	A	Quadrotor	2	2 Con. C90 @ 85 hp.						1 350		4	4	19'		30' 3"	9' 5"	8' 3"
Doman Helicopters, Inc. *Danbury Conn.*	LZ-5	YH-31	7 9	1 Lyc. 8O580-D @ 800 hp 1 Lyc. 8O580-D @ 400 hp.	85 108	500 1 300	5 000 1 900		50 87	5,000 4 415	2 893 3 860	1 1	4 4	48' 48'		28' 28'	5' 6'	10' 8" 10' 5"
Gyrodyne Co. of America Inc. *St. James, L.I., N.Y.*	3C 3 3A 3B	Helidyne	7 15 3 7S	1 P&W R-85 @ 450 hp. 2 P&W R1340 @ 1,300 hp. 2 Turboprop 2 Turboprop	87 150 115 304	1 000 1 000 1 000 2 250		250 350 120 900	100 195 333	5 300 12 800 70 000 80 000	3 600 7 600 21,020	3 2 2 2	2 2 2 4	48' 62' 115 88	102	48' 62' 110 86	18' 5" 4' 4"	14' 8" 15' 8"
Hiller Helicopters, Inc. *Palo Alto Calif*	UH-12B HJ-1	H-23B YH-32	3 2	1 Fr 6V4-200-C32 @ 200 hp. 2 Hiller ramjet @ 32 lb.t.	90 76	770 850	3 200 4 000*	140 81	38 52	3 500 1,950	1 800 430	1 1		35' @*	38.8	27' 6" 28' 2"	3' 5"	9' 10" 8'
Jacobs Aircraft Engine Co. *Pottstown, Pa.*	104*		5	1 Jacobs R755 EH @ 330 hp.	170	1 000	4 000	600	35	2 527	2,350	1	2	38'	45	26' 4"	14'	10' 10"
Kaman Aircraft Corp. *Windsor Locks, Conn*	K-240 K-2 K-5	HTK-1 HOK-1	5 4 3	1 Lyc. O435 @ 240 hp. 1 P&W R1340 @ 600 hp 1 Boeing 502-2 @ 180 hp.		1 050	2,700		40	2 100	2,150	2 2 3	2 2 2	40' 47'		40' 47'	3' 9" 3' 4"	12' 9" 10' 2"
McCulloch Motors Corp. **Aircraft Division** *Los Angeles, Calif*	MC-4C	YH-30	2	1 Fr 6A4 200-C6 @ 200 hp.	110	1 000	4 000	200	35	2,200	1 000	1	2	28'		32' 5"	4' 2"	9' 3"
McDonnell Aircraft Corp. *St. Louis, Mo.*	30 32	XHCH-1 XV-1*	4	1 Con. @ 460 hp.								1	3					10'
Piasecki Helicopter Corp. *Morton Pa.*		YH-16 YH-16A	43 62	2 P&W R2190-11 @ 1,650 hp. 2 All T38 @ 1,800 hp.	125+			300		20 000+		2 2	3 3	80 82		77' 9" 77' 9"	28' 2" 23' 2"	25' 25
	PD-22 PH-43 PD-18 PD-18	H-21A H-21B & C H-25A HUP-2	12 22 8 3	1 Wr R1820-103 @ 1 100 hp. 1 Wr. R1820-103 @ 1 425 hp. 1 Con. R975-42 @ 525 hp. 1 Con. R975-42 @ 535 hp.	140+ 140+ 100 100	1 300 1 000 1 000	3 800	300 300 400* 900*	300 300 100 150	14 000+ 14 000+ 9 100 3 100	8,000 3,328 4,182	2 2 2 2	3 3 3 3	44' 44' 35' 35'		93' 93' 32' 32'	6' 14' 9" 6' 14' 9" 8'	13' 8" 13' 8" 13' 2"
Sikorsky Aircraft Division **United Aircraft Corp.** *Bridgeport Conn.*	S-52 S-55 S-56	YH-18 H-19A XHR3S-1	4 9-12 28*	1 Fr 6V6-25-B17F @ 245 hp. 1 P&W R1340-S1H1 @ 600 hp. 2 P&W R2800 @ 1 000 hp.	111 100 150+	1,000 1 330	2 500 7 000	305 410 200*	80 185	2,700 5 855 26,000	1 825 4,755	1 1 1	3 3 3	33' 53'	42.8 70.1	9' 43' 2"	3' 5"	8' 8" 13' 4"

* — Approximate.
AHC — American Helicopter Co.
All — Allison
‡ Convertiplane
Con — Continental
Fr — Franklin (Airmale I Motors).
Lyc. — Lycoming
P&W — Pratt & Whitney Aircraft
Wr — Wright.

USSR Military Aircraft

Category	Designation	No. of crew	Powerplant: Powerplant no., designation and power, each	Physical Data: Wingspan, ft.	Physical Data: Overall length, ft.	Physical Data: Gross weight, lb.	Armament	Performance: Max. speed, mph.	Performance: Service ceiling, ft.
FIGHTER	MiG-15/1	1	1 x VK-1 @ 5,000 lb.t.	33 1	33 2	15,233	2 x 23-mm. 1 x 37-mm.	550	40,000
	MiG-15/2	1	1 x VK-1A @ 6,750 lb t	33 1	35 2	14 280	2 x 23-mm. 1 x 37-mm.	680	51,000
	La-17	1	1 x VK-1 @ 6,000 lb.t.	37 3	40 0	...	2 x 23-mm.	612	46 000
NIGHTFIGHTER	MiG-17	1	2 x VK-1 @ 6,000 lb t.	33 0	33 7	...	4 x 23-mm.	680	51 500
	D-26	2	2 axial @ 6,000 lb.t.	60 0	60 0	...	4 x 23-mm	580	46,000
GROUND SUPPORT	Il-10	2	1 x AM42 @ 2,000 hp.	45 3	40 3	...	2 x 20-mm 2 x 7.62-mm.	380	27,000
	La-17/3	2	1 x VK-1 @ 6,000 lb.t.	37 0	41 0	...	3 x 20-mm.	600	40,000
MEDIUM BOMBER	D-69	3	2 axial @ 5,000 lb t	72 0	80 0	...	4 x 20-mm.	590	45 000
	Il-38/2	3	2 axial @ 5,500 lb.t.	72 0	72 0	...	2 x 23-mm.	550	46 000
	Tu-12	3	2 axial @ 5,000 lb.t.	72 0	60 0	...	2 x 23-mm.	580	45 000
	Pe-2	3	2 x VK-105R @ 1 100 hp.	56 1	41 2	18,930	2 x 12.7 mm. 4 x 7 62-mm.	330	26,000
	Tu-2	3	2 x ASH82FNU @ 1,880 hp.	60 0	45 3	23,220	4 x 12.7-mm.	330	32,000
HEAVY BOMBER	Tu-4[1]	8-9	4 radial @ 2,200 hp.	141 0	99 0	...	...	293	[illegible]
	Tu-200	14	8 x turboprop @ 4,880 eshp.	230 0	200	...	10 x 20-mm. 5 turrets	465	50,000
	Il-38	6	4 x turboprop @ 3,800 eshp.	138 2	132 7	...	8 x 20-mm. 4 turrets	480	60,000
TRANSPORT	Il-12	2	2 x ASH82 @ 1 750 hp.	100 0	74 2	37,080	None	260	...
	Il-18	2	4 x ASH82FNU @ 1,850 hp.	110 0	98 0	...	None	235	...
	Tu-4(70)	4	4 x radial @2,200 hp.	141 3	110 0	...	None	215	...
	Li-2[2]	2	2 x M63 @ 1 000 hp	96 0	[illegible]	26 000	None	230	[illegible]
COMMUNICATION AND LIAISON	Po-2	2	1 x M11 @ 110 hp.	37.5	26 7	1,900	None	90	13 000
	Yak-14	2	1 x M11 @ 145 hp.	39 2	26 7	2,646	None	123	20 000
BASIC TRAINER	Po-2	2	1 x M11 @ 110 hp.	37 3	26.7	1,900	None	93	13,120
	Yak-18	2	1 x M11FR1 @ 160 hp.	34 2	26 3	2,350	None	160	...
ADVANCED TRAINER	Yak-11	2	1 x ASH21 @ 750 hp.	31 0	28 0	4,850	None	274	...
	La-7	2	1 x ASH82FNU @ 1,850 hp.	32 2	29 3	...	None	370	...
FIGHTER TRAINER	MiG-15	2	1 x VK-1 @ 6,000 lb.t.	33 1	33 2	...	2 x 23-mm. 1 x 37-mm.	630	47,000
	Yak-15B	2	1 x axial @ 6,000 lb.t.	30 0	30 0	...	None	600	42,000
BOMBER TRAINER	B-25[3]	4	2 x radial @ 1 700 hp.	67 6	52 0	33,000	None	280	...
	Il-27	2	2 x axial @ 5,000 lb.t.	68 0	60 0	...	None	580	[illegible]
HELICOPTER	Omega III	2	2 x ASH21 @ 700 hp.	...	...	...	...	...	...
	Mi-1	3	...	...	...	...	...	...	...
FLYING BOAT	MDR-6	3	2 x M62 @ 1,000 hp.	68 0	49 2	...	4 x 7 62-mm	190	...
	GST[4]	2	2 x M62R @ 1 000 hp.	104 0	63 3	27,080	...	190	18,000
MISCELLANEOUS, STILL IN SERVICE	Yak-15	1	1 x axial @ 2,480 lb.t.	31 0	29 0	...	2 x 12.7-mm.	530	[illegible]
	Yak-9P	1	1 x VK105PF @ 1,120 hp	32 0	28 2	7,300	1 x 20-mm 2 x 12.7-mm.	360	...
	La-11	1	1 x ASH82FNU @ 1850 hp.	31 5	27 3	...	3 x 20-mm.	445	...
	Yak-12	2	1 x ASH21 @ 750 hp.	[illegible]	31.0	14,112	None	190	...
	UT-2	2	1 x M11 @ 110 hp.	33.5	23.5	2,073	None	124	...
	Il-4	2	2 x VK105 @ 1120 hp.	...	...	...	3 x 12.7-mm.	...	...

Eshp.— Equivalent shaft horsepower
Hp. — Horsepower
Lb.t. — Pounds thrust.

[1] Russian-built Boeing B-29.
[2] Lend-lease Douglas C-47.
[3] Lend-lease North American B-25.
[4] Lend-lease Convair PBY.

NOTE Russian aircraft and engines have been identified either by function or by the last name of the designers.
The former system was used from 1925 to 1940, and some planes (for example the UT-2 trainer-(Uchebny Trenirovochny)-for instructional and training) still retain the old designation.

Since 1940 the practice has been to use the first two or three letters of the designer's last name. These designations appear in the table

AM — A. A. Mikulin
ASH — A. D. Shvetsov
G — Mikhail Gurevich
Il — Sergei Ilyushin
La — Semyen Lavochkin
M — Motor (old system)
Mi — Artem Mikoyan
Mil — Mikhail Mil
Pe — Vladimir Petlyakov
Po — Nikolai Polikarpov
Tu — Andrei Tupolev
Yak — Aleksandr Yakovlev

Foreign Military & Civil Aircraft

Manufacturer and Address	Designation		Mission	Seats: No. of crew passengers	Powerplant: Number, make, model and max. takeoff power of engine	Max. speed (mph.)	Fuel: Normal fuel capacity (gal.)	Weights: Max. gross weight (lb.)	Weights: Empty weight (lb.)	Dimensions: Overall span	Dimensions: Overall length	Dimensions: Overall height	Dimensions: Wing area (sq. ft.) including ailerons
AUSTRALIA													
Commonwealth Aircraft Corp. Pty Ltd.	CA 25	Winjeel	Trainer	3	1 P&W R985-SB-3 @ 450 hp.	187	88 6	4 265	3 240	38' 8"	27' 2"	9'	246
Fishermen's Bend	CA 27	Sabre Mk. 32	Fighter	1	1 R-R Avon 26 @ 7,500 lb.t.	700*	425	20 000*	11 000*	37' 1"	37' 6"	14' 8"	287 9
Government Aircraft Factories *Fishermen's Bend*		Canberra B.20	Bomber	2	2 R-R Avon		—	51 000		64'	65' 6"	15' 6"	960
CANADA													
Canadair Ltd.	CL-21		Transport	[illegible]	2 Wr. 58HE @ 1,600 hp.			35 000*		90'	67' 5"	26' 3"	
Montreal, P.Q.	Sabre 5		Fighter	1	1 AvC Orenda @ 6,500 lb. t.	690*				37'*	37' *	14' *	
de Havilland Aircraft of Canada, Ltd.	D.H.C.2	Beaver	Transport	1-5	1 P&W R985 @ 450 hp.	163	95	5 100	2 850	48'	30'	10' 5"	250
Toronto, Ont	D.H.C.3	Otter	Transport	1-10-14	1 P&W R1340 @ 600 hp.	160	214	7 600	4 345	58'	41' 10"	15	375
A. V. Roe Canada Ltd. *Malton, Ont.*	CF-100 Mk 4		AW Fighter	2	2 AvC Orenda 9	650*		34 000*		52	52 4"	15' 1"	540
GREAT BRITAIN													
Sir W. G. Armstrong Whitworth Aircraft Ltd. *Baginton nr Coventry*		Meteor N.F.12	AW Fighter	2	2 R-R Derwent					43'	50' *	13' 11"	374
Auster Aircraft Ltd.	J 5B	Autocar	Personal	1-3	1 DH Gipsy Major 1 @ 130 hp.	115	38 5	2 400	1 413	36	23 2"	6' 3"	184 5
Rearsby Aerodrome	J 5F	Aiglet	Trainer	1-2	1 DH Gipsy Major 1 @ 130 hp.	125 5	38 5	1 950	1 324	32	23 2"	6' 3"	154
Rearsby Leicester	J 5F	Aiglet	Personal	1-2	1 DH Gipsy Major 1 @ 130 hp.	122 5	38 5	2 200	1 324	32'	23 2"	6' 3"	164
	J 5G	Autocar	Personal	1-3	1 Bl Cirrus Maj. 3 @ 140 hp.	125	38 5	2 450	1 367	36'	23 7½"	6' 5"	184 5
	A.O.P.9		Liaison	2	1 Bl Bombardier @ 172 hp.					36' 5"	23 8½"	8' 5"	
Aviation Traders Ltd *London*	Accountant		Transport	22-28	2 R-R Dart 5	290*		24 000		—			
Blackburn & General Aircraft Ltd.	G.A.L.60	Beverley	Transport	4	4 Br. Centaurus					162	99 2"	38' 9"	2,916
Brough, E. Yorkshire		Universal Transport	Transport	3,173	4 Br. Centaurus 173 @ 2,850 hp.	234	1,320	135 000	78,500	162'	99 2"	38' 9"	2,916
Boulton Paul Aircraft Ltd.	P.108A	Balliol T.2	Trainer	2	1 R-R Merlin 35 @ 1,280 hp.	202	150	8,410	6 730	39' 4"	35 1"	12' 6"	250
Wolverhampton	P.111A	—	Research	1	1 R-R Nene		—			33' 6"	26 1"	12' 6"	—
Bristol Aeroplane Co. Ltd.	170	Freighter 31	Transport	3;56	2 Br. Hercules 734 @ 2,020 hp.	230		44 000	25 547	108'	68 4"	20' 3"	1,487
Filton House, Bristol	175	Britannia 100	Transport	5-92	4 Br. Proteus 705 @ 3,780 ehp.		6 100	140 000	77 730	142' 3½"	114'	36' 8"	2,055
	175	Britannia 250	Transport	8-6 37	4 Br. Proteus 755 @ 4,150 ehp.		—	155 000	80 890	142' 3½"	124' 3"	36' 8"	2,055
	175	Britannia 300	Transport	8-9 151	4 Br. Proteus 755 @ 4,150 ehp.			155 000	80 635	142' 3½"	124' 3"	36' 8"	2,055
de Havilland Aircraft Co. Ltd.	D.H.100	Vampire F.B.5	Fighter	1	1 DH Goblin 3 @ 3,350 lb. t.	550	475	12 350	7 250	38'	30' 9"	8' 2"	262
Hatfield, Hertfordshire	D.H.115	Vampire T.11	Trainer	2	1 DH Goblin 35 @ 3,500 lb. t.	545	300	11 150	6 900	38'	34 5"	7'	262
	D.H.104	Dove	Transport	2-8-11	2 DH Gipsy Queen @ 330 hp.	210	254	8 500	5 650	57'	39 4"	13' 4"	335
	D.H.106	Comet 1	Transport	4,36	4 DH Ghost 50 @ 5,000 lb. t.		7 000	105 000		115'	93	28'	2,015
	D.H.106	Comet 1A	Transport	4,44	4 DH Ghost 50 @ 5,000 lb. t.		7 000	115 000		115'	93	28'	2,015
	D.H.106	Comet 2	Transport	4,44	4 R-R Avon 503 @ 7,000 lb. t.	500+	8 400	120 000		115'	96	28'	2,015
	D.H.106	Comet 3	Transport	4,58-76	4 R-R Avon 16 @ 8 000 lb. t.		5 000+	145 000		115'	111		2 015
	D.H.110		AW Fighter	2	2 R-R Avon	700+				52' 1½"	51		
	D.H.112	Venom F.B.1	Fighter	1	1 DH Ghost	600+				41' 8"	31' 10"		
	D.H.113	Venom N.F.2	AW Fighter	2	1 DH Ghost @ 5,000 lb. t.	600*				41' 10"	31 11"		
	D.H.112	Sea Venom N.F.20	AW Fighter	2	1 DH Ghost @ 5,000 lb. t.	600*							
	D.H.114	Heron 1	Transport	2-14-17	4 DH Gipsy Queen @ 250 hp.		398	13 000	7 854	71' 6"	48 6"	14' 2"	499
	D.H.114	Heron 2	Transport	2-14-17	4 DH Gipsy Queen @ 250 hp.		380	13 000	8 016	71' 6"	48 6"	14' 2"	499
	D.H.C.1	Chipmunk	Trainer	2	1 DH Gipsy Major 8 @ 145 hp.	138	24	2 000	1 417	34 4"	25' 5"	7' 1"	172 5
(Airspeed Division) *Christchurch, Hampshire*	A.S.57	Ambassador	Transport	?40-49	2 Br. Centaurus 661 @ 2,000 hp.	300	1,200	52 500	33 781	115'	81'	18' 6"	1,200
English Electric Co., Ltd.		Canberra B.5	Bomber	[illegible]	2 R-R Avon					64	65' 6"	15' 7"	960
London		Canberra T.4	Trainer	[illegible]	2 R-R Avon					64	65' 6"	15' 7"	960
		Canberra P.R.7	Photo	2	2 R-R Avon					64	66' 8"	15' 7"	960
Fairey Aviation Co., Ltd.	F.D.1		Research	1	1 R-R Derwent @ 3,600 hp.					19' 7"	26' 5"		
Hayes, Middlesex		Firefly A.S.7	ASW	3	1 R-R Griffon 59 @ 2,470 hp.					44' 6"	38' 3"	13'	
		Gannet A.S.1	ASW	3	1 AS Double Mamba @ 2 950 hp.					54' 4"	43	13' 8½"	
Gloster Aircraft Co Ltd.		Meteor T.7	Trainer	2	2 R-R Derwent 5 @ 3,600 lb. t.	558	700	14 190	10 675	37' 2"	43 6"	13'	350
Hucclecote, Gloucester		Meteor F.8	Fighter	1	2 R-R Derwent 8 @ 3,500 lb. t.	598	795	15 700	10 875	37' 2"	44' 7"	13'	350
		Meteor F.R.9	Recon	1	2 R-R Derwent 8 @ 3,500 lb. t.	590	798	15,500	10,790	37' 2"	43 5"	13'	350
		Javelin F.1	AW Fighter	2	2 AS Sapphire @ 8,000 lb. t.	700+		27 000*		52'	57'	16'	930*
Handley Page Ltd.	H.P.80	Victor	Bomber		4 AS Sapphire @ 8,000 lb. t.	600*				120'*			
Cricklewood, London		Marathon T.2	Trainer	5	4 DH Gipsy Queen @ 340 hp.	198	501	17 538	12 358	65'	52' 1½"	14'	498
	H.P.R.3		Transport	2-35-44	4 Al. Leonides @ 870 hp.	273	844	33 600	20 132	92'	70' 3"	20' 6"	850
Hawker Aircraft Ltd.		Sea Hawk	Fighter	1	1 R-R Nene 4 @ 5,000 lb. t.	600*				39'	40'	8' 6"	278
Kingston-on-Thames	F.1067-1	Hunter F.1	Interceptor	1	1 R-R Avon 7 @ 7,500 lb. t.	700+				33' 8"	45 3"		
Surrey	F.1067-2	Hunter F.2	Interceptor	1	1 AS Sapphire @ 8,000 lb. t.	700+				34' *	45'*		
Percival Aircraft Ltd.	P.50	Prince 5	Transport	1-2 10-16	2 Al. Leonides 24 @ 450 hp.	220	228	12 000	8 095	56' 6"	42' 10"	16' 1"	400
Luton, Bedfordshire	P.56	Provost T.1	Trainer	2	1 Al. Leonides 25 @ 550 hp.	200	79	4 250	3 321	35' 2"	29'	12'	214
A. V. Roe & Co. Ltd.	696	Shackleton G.R.3	ASW	10	4 R-R Griffon					120'	77' 6"	17' 6"	1,421
Greengate, Middleton	698	Vulcan B.2	Bomber		4 Br. Olympus	600*							
Manchester	707A		Research	1	1 R-R Derwent					34' 2"	42' 6"	11' 9"	
	707B		Research	1	1 R-R Derwent					33'	41'	11' 5"	
	707C		Research	2	1 R-R Derwent					34' 2"	42' 3½"		

(Footnotes on page 212)

Foreign Military & Civil Aircraft

Manufacturer and Address	Designation		Mission	Seats: No. of crew; passengers	Powerplants: Number, make, model and max. takeoff power of engine	Max. speed (mph.)	Fuel: Normal fuel capacity (gal.)	Weights: Max. gross weight (lb.)	Weights: Empty weight (lb.)	Dimensions: Overall span	Dimensions: Overall length	Dimensions: Overall height	Dimensions: Wing area (sq. ft.) including ailerons
Saunders-Roe Ltd. *Osborne, E. Cowes, Isle of Wight*	S.R.45	Princess	Transport	12;150	8 Turboprop		17 300	345 000	172 300	219' 6"	167' 4"	50' 9"	5,019
Scottish Aviation Ltd. *Ayrshire, Scotland*		Pioneer 2	Personal	5	1 AL Leonides 502-4 @ 520 hp.	160	76	5,400	4,000	49' 0"	34' 6"	10'	390
		Twin Pioneer	Transport	1;18	2 AL Leonides 503-1 @ 550 hp.	131	192	13,500	8,075	76' 6"	45' 1"	13' 8"	657
Short Bros. & Harland Ltd. *Queens Island, Belfast Northern Ireland*	S.A.4		Bomber		4 R-R Avon lb. t.					150'	109' 2"	28' 6"	1260 7
	S.B.5		Research	1	1 R-R Derwent lb. t.								
	S.A.6	Sealand	Transport	1-2;5-8	2 DH Gipsy Queen @ 340 hp.	185	142 5	9,100	7,232	61' 6"	42' 8"	14' 1"	369 3
	S.B.4	Sherpa	Research	1	2 Bl. Turbomeca @ 350 lb. t.					38'	31' 9"	9 11"	
	S.B.6	Seamew	ASW	2	1 AS Mamba					55'	41'	13 9"	
Vickers-Armstrongs Ltd. *Weybridge, Surrey*	660	Valiant B.2	Bomber		4 R-R Avon								
	700	Viscount	Transport	2-3;40-53	4 R-R Dart @ 1 200 hp.[5]	340	1,730	55,300	33,380	94'	81' 2"	26' 9"	950
	1000												
(Supermarine Works) *South Marston*	391	Attacker F.B.2	Fighter	1	1 R-R Nene 102 @ 5,000 lb. t.	585	353	12,300	8,430	36' 11"	37' 6"	9' 6½"	230
	508		Fighter	1	2 R-R Avon	650+				41'	50'		
		Swift F.4	Fighter	1	1 R-R Avon								
Westland Aircraft Ltd. *Yeovil Somerset*	W.35	Wyvern S.4	Attack	1	1 AS Python 3 @ 4,110 hp.		399	24,300	16 300	44'	42'	14' 8"	355
FRANCE													
Constructions Aeronautiques du Bearn *Pau*		Minicab	Personal	2	1 Con A65 @ 65 hp.	105	13	1,309	309	52'	18'	5' 6"	107
Avions Boisavia *Ivry sur-Seine*	B.60	Mercurey	Personal	4	1 Renault 4 Pei @ 140 hp.	155		2,300	1,300	34' 11"	23'	6' 10"	155
S. A. des Ateliers d'Aviation Louis Breguet *Paris*	763	Deux-Ponts	Transport	3 105	4 P&W R2800 @ 2,400 hp.	250	8,300	105,727	55,308	140' 10"	88' 11"	31' 4"	1,999
	960	Vultur	Attack	2	1 AS Mamba @ 2,300 hp.	300		22,304	18 453	55' 8"	42' 8"	10' 8"	
Avions Marcel Dassault *Paris*	M D 315	Flamant	Transport	2-10	2 Renault 12-S @ 580 hp.	236		12,395	9,359	66'	42'	16'	500
	M D 450	Ouragan	Fighter	1	1 Hisso Nene @ 5,066 lb. t.	612	250	11,684	7,260	38' 7"	34' 9"	13'	259
	M D.452	Mystere 2	Fighter	1	1 Hisso Tay @ 6,275 lb. t.	700		15,000		38'	38'		
		Mystere 4	Fighter	1	1 Hisso Verdon @ 8,300 lb. t.	700							
Avions Hurel-Dubois *Meudon-Villacoublay*	H D.10		Research	1	1 Praga D @ 75 hp.	121		1,144	726	36' 4"	19' 10"		464
	H D.31		Transport	2;24	2 Wr. C7BA1 @ 800 hp.	174		26,232	18 300	147' 7"	72' 6"	21 10"	1 077
	H D.32		Transport	3;42	2 P&W R1820-92 @ 1,200 hp.	188		38,170	22,118	147' 7"	72' 6"	21 10"	1 077
	H.D.45		Transport	30	2 Turbojet @ 9,000 lb. t.			90 405		147' 7"			1 155
Ets Fouga & Cie *Paris*	C.M.8R.00	Cyclope 2	Trainer	1	1 Turbomeca Palas @ 330 lb. t.	218		16235	209	28' 0"	21' 10"	6' 10"	108
	C.M.170R	Magister	Trainer	2	2 Turbomeca Marbore @ 835 lb. t.	420	170	6,166	5,330	37' 9"	33' 3"		186
Societe Francaise D'Etudes et de Construction de Materiels Aeronautiques Speciaux *Chatillon-Sous-Bagneux*	1600	Gerfaut	Fighter	1	1 Atar 101C @ 6,266 lb. t.								
Societe Max Holste *Paris*	M.H 1521	Broussard	Personal	1;5	1 P&W R985 @ 455 hp. lb.t.	162		3,800	2,212	46	27'		
Societe Morane-Saulnier *Puteaux (Seine)*	M.S 733		Trainer	2	1 Potez 6D30 @ 240 hp.	154	50	3,800	3 300	37'	31' 8"	11' 4"	237
	M.S.755		Trainer	2	2 Turbomeca Marbore @ 880 lb. t.	380+	105	6,338	4,927	31'	31' 8"	9'	154
Societe Industrielle pour L Aeronautique *Suresnes*	S.12		Trainer	2	1 Salmson 125 @ 454 hp.	210	60	5 320	4 035	28' 1"	30' 8"	9'	160
	S.200		Personal	2	1 Turbomeca Palas @ 330 lb. t.	251		1 300	800	23' 8"	17'	6' 10"	83
	S.901		Trainer	2	1 Minie 4DC30 @ 75 hp.	124		1 000	600	26' 8"	18' 10"	5' 9"	100
Societe Nationale de Constructions Aeronautiques du Sud-Est *Paris*	S.E. 210	Caravelle[1]	Transport	5 70	2 Hisso Avon R.A. 16 @ 8,000 lb.t.		4 600	88,260	41,800	110' 6"	109' 4"	29' 4"	1 571
	S.E.2010	Armagnac	Transport	7-11;80-107	4 P&W R4360-B-13 @ 3,500 hp.	300	5 308	153 000	84 070	160' 1"	129' 8"	42' 7"	8,453
	S.E.2410	Grognard	Attack	2	2 Hisso Nene @ 5 065 lb. t.	593		24 110		50' 7"	54' 9"	13'	463
		Mistral	Fighter	1	1 Hisso Nene 102 @ 5,066 lb. t.	578		16 000	7,700	38' 8"	31'		260'
	S.E.5000	Baroudeur	Fighter	1	1 Snecma Atar 101C @ 6,100 lb. t.	650				32' 10"	44' 8"	11' 9"	
Societe Nationale de Constructions Aeronautiques du Sud-Ouest *Paris*	S.O 30-P	Bretagne	Transport	4;30-43	2 P&W R2800 @ 2,400 hp.	267	1,270	44 300	30,580	82' 2"	62' 2"	16' 1"	927 8
	S.O.30 Nene		Transport	4	2 Hisso Nene @ 5000 lb. t.	435	1 640	38 300	27 300	83' 7"	61'		616
	S.O.4050	Vautour	Attack	1	2 Atar 101E @ 8,230 lb. t.	600*							
	S.O.9000	Trident	Fighter	1	2 Turbomeca Marbore 2 @ 880 lb. t.[8]	300*							
Societe Des Avions et Moteurs Henry Potez *Paris*	75		Attack	2	1 Potez 8D32 @ 480 hp			5,280	3,380	42' 8"	32' 10"		
HOLLAND													
Royal Dutch Aircraft Factories (Fokker) *Schiphol, Amsterdam*	S.11	Instructor	Trainer	2	1 Lyc. O435-A @ 190 hp.	180	37	2 360	1,780	36' 6"	27'	7' 11"	199
	S.12	Instructor	Trainer	2	1 Lyc. O435-A @ 190 hp.	156	37	2 410	1,880	36' 6"	27'	10' 6"	199
	S.13		Trainer	2	2 P&W R1340 @ 600 hp.	220	325	13 730	9,225	83'	44' 7"	16'	499
	S.14		Trainer	2	1 R-R Derwent 8 @ 3,470 lb. t.	450	450	11 200	8,800	39' 6"	45' 8"	15' 4"	260
	S.14-2		Trainer	2	1 R-R Nene 2-1 @ 5,100 lb. t.	500	500	12 300		39' 5"	43' 8"	15' 4"	242
	F.27	Friendship	Transport	3;28-36	2 R-R Dart @ 1,080 hp.	280	845	34 300	20 810	95'	73'	26' 3"	754

(Footnotes on page 212)

Foreign Military & Civil Aircraft

Manufacturer and Address	Designation		Mission	Seats: No. of crew/ passengers	Powerplants: Number, make, model and max. takeoff power of engine	Max. speed (m.p.h.)	Fuel: Normal fuel capacity (gal.)	Weights: Max. gross weight (lb.)	Weights: Empty weight (lb.)	Dimensions: Overall span	Dimensions: Overall length	Dimensions: Overall height	Wing area (sq. ft.) (including ailerons)
ITALY													
S. A. I Ambrosini *Roma*	S.7	Supersette	Personal	1 2	1 Alfa Romeo 115 @ 230 hp.	173	40	3 050	2 350	28' 9"	28' 9"	9' 0"	187 8
	G.F.4	Rondone	Personal	2	1 Walter Mikron @ 65 hp.	140	18 6	1 210	748	25' 2½"	20' 2"	9' 2"	114
Soc. Aero Caproni *Trento*	F.5		Trainer	2	1 Turbomeca Palas @ 330 lb. t.	248	36 4	1 650	1 062	26' 0"	21' 0"	8'	107
FIAT—Sezione Aviazione *Turin*	G 46–2B		Trainer	2	1 DH Gipsy Queen @ 245 hp.	204	42	3 150	2 480	34' 1¼"	27' 10"	7' 10½"	172 9
	G 46–4B		Trainer	2	1 Alfa Romeo 115 @ 225 hp.	194	42	3 145	2 425	34' 1¼"	27' 10"	7' 10½"	172 2
	G.49–1		Trainer	2	1 Al. Leonides @ 570 hp.	228	90	5 090	4 510	40' 11"	31' 5"	9' 2"	255
	G 49–2		Trainer	2	1 P&W R1340 @ 550 hp.	230	90	5 930	4 510	40' 11"	30' 10"	9'	255
	G 59–4A		Trainer	1	1 R-R Merlin @ 1 400 hp.	380	127	7 530	6,180	38' 10½"	31' 1"	12' 1"	227
	G 59–4B		Trainer	2	1 R-R Merlin @ 1 400 hp.	380	100	7 465	6 285	38' 10½"	31' 1"	12' 1"	227
	G 80–3B		Trainer	2	1 DH Goblin 35 @ 3,500 lb. t.	525	370	12 570	9 280	35' 1"	41' 10"	13' 3"	270 0
	G 82		Trainer	1	1 R-R Nene @ 5 000 lb. t.	555	470	13 500	9 700	38' 1"	42' 5"	13' 9"	270 0
	G.212–CP	Monterosa	Transport	4;26–30	3 P&W R1830 @ 1 200 hp.	235	1 185	38 700	24 700	98' 3"	75' 7½"	21' 4"	1 258
Aeronautica Macchi *Varese*	M.B.308		Personal	3	1 Con. C85 @ 85 hp.	118	22	1 433	915[1]	32' 8"	21' 5"	7' 1"	147 5
	M.B.320		Personal	1,5	2 Con. E185 @ 185 hp.	200	68	4 630	3,234[1]	42' 7"	28' 5"	10' 6"	227 1
	M.B.323		Trainer	1	1 P&W R1340-S3H1 @ 610 hp.	230	110	5 500	4,245	39' 9"	30'	13' 3"	218
SIAI-Marchetti *Sesto Calende*	S.M 102		Transport	2;8–10	2 P&W R985 @ 450 hp.	210	196	11,126	7,500	59'	43'	10' 5"	437
Nardi Soc. per Costruzioni Aeronautiche *Milan*	F N.333		Personal	1;3	1 Con. 047-A 600 hp.	100	44	2 000	1 600	32' 8"	23'	8' 9"	165 3
Piaggio & Co. S. p. a. *Genoa*	P 136–L		Personal	1;4	2 Lyc. GO435 C2 @ 260 hp.	173	160	5 730	3 900	44' 5"	35' 5"	11' 0"	268
	P 136–M		Rescue	2;3	2 Fr 6A8-215-B9F @ 215 hp.	164	160	5 600	4 130	44' 5"	35' 5"	11' 0"	268
	P 148		Trainer	2	1 Lyc. O435-A @ 190 hp.	145	45	2,045	1 931	36' 6"	27' 8"	7' 10½"	202 9
	P 149		Personal	1;3	1 Lyc. GO 435-C2 @ 260 hp.	194	60	3 105	2 150	36' 6"	28' 1"	9' 0"	202 5
	P 150		Trainer	2	1 P&W R1340-S3H1 @ 600 hp.	237	104	5 000	4 277	42' 4"	30' 4"	9' 2"	271 3
SWEDEN													
Svenska Aeroplan A.B. *Linköping*	Saab-29	J-29	Fighter	1	1 DH Ghost @ 5,000 lb. t.	660				36' 1"	33' 2½"	12' 3½"	258
	Saab-29C	S-29C	Photo	1	1 DH Ghost @ 5,000 lb. t.	660				36' 1"	33' 2½"	12' 3½"	258
	Saab-32	A-32 Lansen	Attack	2	1 R-R Avon	750+		22 000[1]		42' 3"	45' 2"	15' 3"	
	Saab-90A-2	Scandia	Transport	2–5;32–40	2 P&W R2180E-1 @ 1 800 hp.	280	776	35 850	21 000	91' 10"	65' 11"	23' 3"	922
	Saab-91C	Safir	Personal	4	1 Lyc. O435-A @ 190 hp.	163	40	2 085	1 650	29' 0"	26'	7' 2"	146
	Saab-210	Draken	Research	1	1 AS Adder @ 1,050 lb. t.								

* — Approximate.
Al. — Alvis.
AS — Armstrong Siddeley
ASW — Anti-submarine warfare
AvC — A. V. Roe Canada.
AW — All weather

Bl — Blackburn.
Br — Bristol.
Con. — Continental
DH — de Havilland.
Fr. — Franklin (Aircooled Motors).

Hp. — Horsepower
Lyc. — Lycoming
P&W — Pratt & Whitney Aircraft.
Recon. — Reconnaissance.
R-R — Rolls-Royce.
Wr. — Wright.

[1] Freighter Mk. 38 carries 20 passengers. Length is 73' 5".
[2] Retractable tricycle landing gear. Heron I has fixed gear.
Two prototypes being built.

[4] Wings folded.
[5] Cruise power is 1,650 hp. Later versions have 1,800 hp. on takeoff
[6] Plus a 5,000-lb. thrust Hiso Nene turbojet in the tail.
[7] Two prototypes being built.

[8] Engines mounted at wingtips. A SEPR rocket motor will be located in the tail.
[9] Being produced under Saab subcontract by the Dutch De Schelde plant at Dordrecht, which is also making the three-place Saab-91 G under a similar contract.

Leading Foreign Helicopters

Manufacturer and Address	Designation		Seats (including crew)	Powerplant: Number, make, model and takeoff power of engine	Performance: Maximum speed (mph.) @ ft.	Performance: Initial rate of climb (fpm.) @ SL, fully loaded	Performance: Hovering ceiling (ft.) in ground effect	Performance: Normal all-up range (mi.)	Fuel: Normal fuel capacity (gal)	Weights: Allowable takeoff gross weight (lb.)	Weights: Empty weight (lb.)	Main Rotor: No. of rotors	Main Rotor: Blades per rotor	Main Rotor: Rotor diameter	Main Rotor: Total rotor blade area (sq. ft.)	Dimensions: Max. length (blades unfolded)	Dimensions: Fuselage maximum width	Dimensions: Overall height to top of rotor
GREAT BRITAIN																		
Bristol Aeroplane Co., Ltd. *Filton, Bristol*	171 Mk. 4	Sycamore	4-5	1 Al. Leonides @ 340 hp.	126			285	65	6,000	3,377	1	3	48' 7"		51' 1"		9' 4"
	173 Mk. 3	Rotocoach	16	2 Al Leonides @ 850 hp.	186		11,000	187	388	12,500	6,300	2	6	49' 7"				14'
Fairey Aviation Co., Ltd. *Hayes, Middlesex*		Rotodyne [1]	40+	2 turbine				400*		31,000	18,000*		3	90'				
Percival Aircraft, Ltd. *Luton, Bedfordshire*	P 47		10	1 Napier jet						8,000	4,000*	1	3					
Saunders-Roe Ltd. *Osborne, E. Cowes, Isle of Wight*		Skeeter	2	1 Bl. Bombardier @ 190 hp.		1,300	6,200		95	2,100	1,476	1	3	32'		35' 3"	7' 4½"	10' 2"
Westland Aircraft Ltd. *Yeovil, Somerset,*	S-51	Dragonfly	4-5	1 Al. Leonides @ 525 hp.	111	700*		220	70*	6,700*	4,682	1	3	49'		53' 3"	11' 6"	13'
	S-55		10-12	1 P&W R1340-40 @ 600 hp.		550	6,000	430	150	8,400	4,750	1	3	53'	97' 5			13' 1"
FRANCE																		
Societe Maire *Boulogne-sur-Seine*	M.C. 101 Cantinsau		2-3	1 Continental @ 185 hp						1,325	880	1	3	23' 8"		35'		7' 6"
Societe Nationale de Constructions Aeronautiques du Sud-Est *Paris*	S.E. 6130 Alouette		6	1 Salmson 9NK @ 200 hp.	84					2,650	1,528	1	3	19'		34' 6"		9'
Societe Nationale de Constructions Aeronautiques du Sud-Ouest *Paris*	S.O. 1110	Ariel 3	6	1 Turbomeca @ 578 hp.	108		6,000	186		3,730	1,466	1	3	33' 6"		24' 7"		
	S.O. 1220	Djinn	3	1 Turbo. Palouste	72		3,280	300		1,100	584	1	2	22' 6"		18'		7' 3"
	S.O. 1310	Farfadet [2]	6	1 Turbo. Artus @ 650 hp. [3]	165*			240				1	3	36' 5"				

* — Approximate AL. — Alvis. Bl. — Blackburn. P&W — Pratt & Whitney Aircraft. Turbo. — Turbomeca.

[1] Convertiplane
[2] Rotor power unit A 360-hp. Turbomeca Artouste turns the nose-mounted propeller. Wingspan is 20' 5". A larger, 30-passenger version is in the design stage
[3] Design cruise speed

BRISTOL 173 MK. 3 ROTOCOACH prototype is twin-engine 16-place type to be used by British European Airways on short hauls.

U. S. Reciprocating Engines

Manufacturer and Address	Designation	No. of cylinders	Cylinder arrangement	Propeller drive	Power Ratings: Max. takeoff power (hp.) — SL	Power Ratings: Max. takeoff power — At rpm	Power Ratings: Normal cruise power (hp.)	Power Ratings: Normal cruise power — At rpm	Power Ratings: Normal cruise power — At altitude (ft.)	Octane fuel	Bore and stroke (in.)	Diameter (without cowling)	Compression ratio	Bmep.	Blower ratio	Gross weight dry (lb.)
Aircooled Motors, Inc. *Syracuse, N. Y.*	4A4-90-B3	4	Ho	Direct	90	2,300				80	4 5x3 5		7	135		200
	4A4-100-B3	4	Ho	Direct	100	2,350				80	4 5x3 5		7	135		208
	6A4-150-B3	6	Ho	Direct	150	2,500				80	4 5x3 5		7	136		278
	6A4-165-B3	6	Ho	Direct	165	2,800				80	4 5x3 5		7	140		278
	6V4 178-B32, B33[1] 0335-3 -4	6	Vo	Direct	178	3,000				80	4 5x3 5		7	140		284
	6AC4 185-B12	6	Ho	G 632 1	185	3,100				80	4 5x3 5		7 6	146		232
	6A4-200-C6	6	Ho	Direct	200	3,100				91	4 5x3 5		8 5	152		307
	6V4 200-C32, C33[1] 0335-3 -6	6	Vo	Direct	200	3,100				91	4 5x3 5		8 5	152		297
	6V8-245-B16[2] 0428 1	6	Vo	Direct	245	3,375				80	4 7x4		7 5	149		372
Continental Motors Corp. *Muskegon, Mich.*	A65-8F	4	Ho	Direct	65	2,300				73	3 875x3 229		6 6	131		170
	C85-12F	4	Ho	Direct	85	2,575				73	4 062x3 625		6 3	126		182
	C90-12F	4	Ho	Direct	85	2,685				80/87	4 062x3 875		7	143		186
	C125-2	6	Ho	Direct	125	2,550				73	4 062x3 625		6 3	126		257
	C145-2	6	Ho	Direct	145	2,700				80/87	4 062x3 875		7	141		235
	O315A	4	Ho	Direct	150	2,600				80/87	5x4		7	143		293
	E185	6	Ho	Direct	185	2,600				80/87	5x4		7	138		355
	E225-8	6	Ho	Direct	225	2,650				80/87	5x4		7	143		385
	O470-A	6	Ho	Direct	225	2,600				80/87	5x4		7	143		352
	W670-23	7	Rad	Direct	240	2,900				80/87	5 125x4 625		6 1	138		455
	GE260-2	6	Ho	G 69 1	260	3,100				80/87	5x4		7			431
Herrmann Engineering Co. *Glendale, Calif*	Cam Engine	16			400	1,600					3 25x2 75		5 5			264
Jacobs Aircraft Engine Co. *Pottstown, Pa.*	R755-A R790 11	7	Rad	Direct	300	3,300				80	5 25x5	44"	6 0	144		600
	R755-B	7	Rad	Direct	375	3,300				80	5 25x5	44"	6 0	132		595
Lycoming Division of Avco Mfg. Corp. *Stratford, Conn.*	326C9HD2[3]	9	Rad	G 690 1	1 425	2,700				100/130	5 125x5 875	50 68"	6 80	229	7 51[4]	1 280
	333C7EA1[3] R1300-1A	7	Rad	G 5625 1	900	2,500				91/98	5 125x5 312	50 45"	6 2	187	7 21	1 066
	385C9ED1[3]	9	Rad	Direct	1 425	2,700				100/130	5 125x5 875	54 68"	6 80	229	7 21[4]	1 350
	435C7EA1[3] R1300-2	7	Rad	Direct	900	2,500				91/98	5 125x5 312	50 45"	6 2	187	7 21	1 066
	801C9HE1[3]	9	Rad	G 5625 1	1 475	2,700				100/130	5 125x5 875	50 68"	6 80	229	7 21	1 464
	867C9HE1[3]	9	Rad	G 5625 1	1 525	2,800				115/145	5 125x5 875	55 74"	6 80	236	7 21	1 445
	871C7EA1[3] R1300-3	7	Rad	Direct	900	2,900				91/98	5 125x5 312	50 45"	6 2	187	7 21	1 066
	895C9HD1[3]	9	Rad	G 606 1	1 425	2,700				100/130	5 125x5 875	54 95"	6 80	229	7 21[4]	1 385
	988C9HE1[3]	9	Rad	Direct	1 525	2,800				115 145	5 125x5 875	55 74"	6 80	236	7 21[4]	1 400
	O235-C1	4	Ho	Direct	115	2,800	51	2,280	5,500	4 375x3 875		68 53x33"	7 75	140		236
	O290-D2	4	Ho	Direct	143	2,500	100	2,350	5,900	80/87	4 875x3 875	23 91x33 24"	7 51	117		290
	O320	4	Ho	Direct	150	2,700	112	2,450	7,900	80/87	5 125x3 875	24 68x32 24"	7 25	135		305
	O435-A	6	Ho	Direct	180	2,550	142	2,300	6,500	80/87	4 875x3 875	29 59x32 24"	6 5	130		392
	O435-H	6	Ho	Direct	200	2,500	142	2,300	6,500	80, 87	4 875x3 875	24 65x32 24"	7	131		362
	O435-K[3] O435-4	6	Ho	Direct	250	3,400	187	3,200	5,900	91/96	4 875x3 875	25 31x33 12"	7 3	140		382
	O435-V	6	Vo	Direct	250	3,400	180	3,100	6,500	80/87	4 875x3 875	33 12"	7 3	140		396
	GO435-C9	6	Ho	G 642 1	250	3,400	180	2,750	6,500	80/87	4 875x3 875	29 59x33 12"	7 3	140		422
	GSO435-B	6	Ho	G 642 1	300	3,400	195	2,750	10,000	91/98	4 875x3 875	32 36x33 12"	7 3	141	5 6	498
	GO-480	6	Ho	G 642	380	3,400	165	2,750	6,500	80/87	5 125x3 875	33 12"	7 3	136		432
	GSO480-B	6	Ho	G 642	340	3,200	310	2,750	16,000	100 130	5 125x3 875	33 12"	7 3	176	11 27	492
	GSO580-C	6	Ho	G 642-1	375	3,300	240	2,750	13,500	91/98	4 875x3 875	30 75x33 18"	7 3	158	7 01	502
	GO580-D[3]	6	Ho	Direct	400	3,300	262	2,750	11,000	100/130	4 875x3 875	35 75x33 18"	7 3	160	7 01	580
	GSO580-D O580-1	6	Ho	G 642 1	400	3,300	262	2,750	11,000	100/130	4 875x3 875	30 75x33 18"	7 3	160	7 01	567
	GO580-V O580-3	6	Vo	Direct	400	3,300	280	2,900	12,000	100/130	4 875x3 875	33 18"	7 3	160	7 0	588
Pratt & Whitney Aircraft Div United Aircraft Corp. *East Hartford, Conn*	R3000-D5	14	Rad	G 690 1	1 450	2,700	300	2,550	6,500	100/130	5 75x5 50	46 10"				1 885
	R2000-2SD13-G	14	Rad	G 690 1	1 450	3,700	200	2,600	5,000	100/130	5 75x5 50	46 10"				1 905
	R2800-CA3	18	Rad	G 690 1	2 400	2,800	1,400	2,600	6,000	100/130	5 75x5 00	52 80"				2 317
	R2800-CB3	18	Rad	G 650 1	2 400	2,800	900	2,600	5,500	100/130	5 75x5 00	52 80"				2 737
	R2800-CD4	18	Rad	G 690 1	2 500	2,800	800	2,600	5,500	100/130	5 75x5 00	52 80"				2 357
	R2800-CA15	18	Rad	G 650 1	2 400	2,800	1,400	2,600	16,000	100/150	5 75x5 00	52 80"				2 350
	R2800-CA18	18	Rad	G 650 1	2 400	2,800	1,000	2,600	14,500	100/150	5 75x5 00	52 80"				2 350
	R2800-CB16	18	Rad	G 650 1	2 400	2,800	1,000	2,600	16,000	100/150	5 75x5 00	52 80"				2 390
	R2800-CB17	18	Rad	G 650 1	2 500	2,800	1,000	2,600	14,000	100/135	5 75x5 00	52 80"				2 390
	R4360-C52	28	Rad	G 675 1	3 500	2,700	1,000	2,600	5,500	100/135	5 75x5 00	55 00"				3 662
Wright Aeronautical Div Curtiss-Wright Corp. *Wood-Ridge, N. J.*	745C18BA3	18	Rad	G 4375 1	2 200	2,800	1,400	2,300	12,400	100/130	6 125x5 315	55 8"	6 5	185	6 80[5]	2 780
	749C18FD1	18	Rad	G 4375 1	2 400	2,800	1,470	2,400	11,000	100/130	6 125x5 312	55 6"	6 6	211	6 46[5]	2 944
	826C9HD8, & 5 R1820-76A, -76B	9	Rad	G 660 1	1 425	2,700				100/130	6 125x5 875	50 00"	6 8	229	7 21[5]	1 350
	826C9ID4 R1820-101	9	Rad	G 5625 1	1 425	2,700				100/130	6 125x5 875	54 95"	6 8	229	7 21[5]	1 390
	836C18CA1 R3350-26WA	18	Rad	G 4375 1	2 700	2,900				115/145	6 125x5 312	55 6"	6 7	220	6 46[5]	2 845
	858C7EA1 R1300-1A	7	Rad	G 5625 1	900	2,600				91/98	6 125x5 312	50 45"	6 2	187	7 21	1 060
	863C9HD1 R1820-130	9	Rad	Direct	1 425	2,700				100/130	6 125x5 875	54 95"	6 80	229	7 21[5]	1 380
	886TC18DA1,[6] R3350-30W	18	Rad	G 4375 1	3 250	2,900				115/145	6 125x5 312	55 6"	6 70	265	6 46[5]	3 000
	895C7EA1 R1300-4	7	Rad	Direct	900	2,600				91/98	6 125x5 312	50 45"	6 2	187	7 21	1 058
	896C9EE1 R1820-80	9	Rad	G 5625 1	1 475	2,500				100/130	6 125x5 875	54 95"	6 6	200	7 21	1 380
	897C9EE1 R1820-82	9	Rad	G 5625 1	1 525	2,800				115/145	6 125x5 875	55 74"	6 8	236	7 21	1 445
	971C7EA1 R1300-3	7	Rad	Direct	900	2,900				91/98	6 125x5 312	50 45"	6 2	187	7 21	1 060
	956C18CA1	18	Rad	G 4375 1	2 700	2,900	1,400	2,400	12,100	115/145	6 125x5 312	50 6"	6 7	220	6 46[5]	2 857
	957C7EA1	7	Rad	G 5625 1	900	2,900	480	2,130	10,600	91/98	6 125x5 312	50 45"	6 2	187	7 21	1 065
	986C9HE1	9	Rad	G 5625 1	1 475	2,900	500	2,400	13,000	100/130	6 125x5 875	54 95"	6 6	220	7 21	1 380
	972TC18DA1 2 R3350-34[7]	18	Rad	G 4375 1	3,250	2,900	1,510	2,450	11,400	115/145	6 125x5 312	60 6"	6 7	265	6 46[5]	3 114
	976C18CB1	18	Rad	G 4375 1	2,600	2,900	1,000	2,400	12,500	115/145	6 125x5 312	50 6"	6 7	226	6 46[5]	3 026
	976C9HE1	9	Rad	G 5625 1	1,535	2,800	500	2,450	12,600	100/130	6 125x5 875	55 76"	6 8	236	7 21[5]	1 450

Bmep. — Brake mean effective pressure.
G — Geared
Ho — Horizontally opposed
Rad — Radial
SL — Sea level
Vo — Vertically opposed.

[1] For helicopter installation.
[2] Manufactured under Curtiss-Wright license.
[3] Or 70.14 1
[4] Or 7.59 1
[5] Or 7.67 1

[6] 886TC18DA1 (R3350-30WA) is similar but has takeoff power (wet) of 3,500 hp. and dry gross weight of 3,445 lb. 886TC18DA1 (R3350-30) is similar to -30WA but weighs 3,439 lb. dry. Some have manifold absolute pressure regulator.
[7] Military engine rated at 3,700 hp. max.

Engineers mount cameras and X-wing on supersonic rocket to test new design.

On California desert, rocket begins flight reaching 3 times the speed of sound.

Desert craters fade away as camera records speed effect on new experimental wing.

Here, another wing design flaps violently from the pressure of the supersonic speed.

Parachuted to earth, rocket camera is recovered with film data vital for the future.

Lockheed Scientists Shape the Forms of Future Flight

Lockheed's Expanding Science Center Improves Today's Planes and Develops New Designs for the Era of Automatic Flight

FIRST IN THE NATION'S ALL-WEATHER DEFENSE Lockheed F-94 Starfires are jet interceptors loaded with electronics for almost automatic flight. Starfires protect vital U. S. cities, even in darkness or bad weather. For 8 years, Lockheed has built more jets than any other manufacturer

The above film strips take you behind the scenes to show Lockheed scientists testing new wing designs for future aircraft many times faster than today's. This is an example of advanced research at Lockheed's expanding Science Center. Scientist-engineers work with nuclear energy, pilotless aircraft, electronics systems, new rockets for the era of automatic flight.

Lockheed discoveries in *pure* science are matched by Lockheed progress in *applied* science. Lockheed's science of design has produced a radar-laden team of protecting military aircraft—flying radar stations, almost automatic interceptors, anti-submarine patrol bombers. Skill in science of production enables Lockheed to produce 12 different models simultaneously—and all models are on schedule!

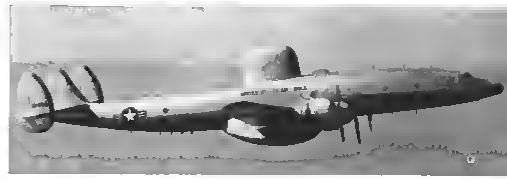
LEADERSHIP DEMANDS CONSTANT ACHIEVEMENT

SCIENCE CENTER—*Future forms of flight are studied here in Lockheed's new Engineering and Science Building.*

Missiles Era

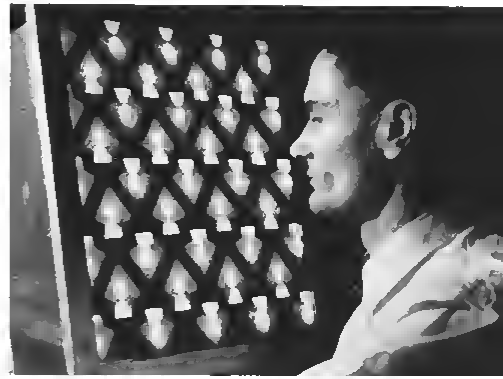
Lockheed's rapidly-expanding Missile Systems Division is now probing into new, unexplored fields of electronics and pilotless aircraft, integrating 10 years of scientific research into practical application for a top-secret project of vital importance to the U. S. This new Missile Systems Division is adding scientific personnel daily, speeding the conquest of automatic flight through space.

FIRST FLYING RADAR STATION Lockheed Super Constellations, with radar humps, provide Navy and U. S. A. F. with new concept of defense—a new method of detecting an enemy hours in advance through applied electronics.



FIRST ELECTRONIC SUB PATROL—Advanced models of Lockheed P2V Neptune Bombers give U. S. Navy long-range sub patrol with destructive power and advanced sonic devices.

TOMORROW'S METALS Planes 10 to 25 years from now, currently under study by Lockheed, will require new materials to withstand tri-sonic speeds. Here Lockheed scientist checks X-ray film of new metal.



COMING SOON—*Look for other dramatic new Lockheed models soon, including XF-104 Day Supersonic Fighter.*

Lockheed

California Division—Burbank, California
Georgia Division—Marietta, Georgia
Missile Systems Division—Van Nuys, California
Lockheed Aircraft Service—Burbank, California
Lockheed Air Terminal—Burbank, California

LOOK TO LOCKHEED FOR LEADERSHIP

U.S. Gas Turbine Engines

Manufacturer and Address	Designation	Type	Compressor stages	Turbine stages	No. of combustion chambers	Max. takeoff power @ sea level	Compression ratio @ max. rpm @ SL	Specific fuel consumption (lb./hr./lb. thrust or eshp.)	Max. length uncowled and minus tailpipe	Max. diameter uncowled and minus tailpipe	Dry weight (lb.) minus tailpipe, cowling and accessories
Allison Division General Motors Corp. *Indianapolis, Ind.*	J33-A-16A	CFJ	1	1	14	6,350 lb.t.	4 6:1	1 08	101¾"	40"	1 920
	J33-A-35	CFJ	1	1	14	5,400 lb.t.	4 4:1	1 14	107"		1 830
	J35-A-35	AFJ	11	1	8	5,600 lb.t.	5 2:1	1 10	195 5"	42"	2 850
	T40-A 10	AFP	19[1]	4[1]	8[1]	5,850 eshp	7 0:1	60	181 5"	58 5	2 565
	T54[2]	AFP				7,500 eshp.*					
	T56.	AFP				6 780 eshp.*					
	J71	AFJ				9,500 lb. t.					
Boeing Airplane Co. *Seattle, Wash.*	XT50-BO-1	ACFP	2	2	2	210 shp	3 2:1	1 3	39 83"	23 0"	267
Fairchild Engine Division Fairchild Engine & Airplane Corp. *Farmingdale, L. I., N. Y.*	J44			1	1	1 550 lb t.*	2 8:1		75 7"	22"	302[3]
General Electric Co Aircraft Gas Turbine Division *Cincinnati 15, Ohio*	J47-GE-17	AFJ	10	1	8	5,200 lb.t.+			226"	00 75"	2 000*
	J47-GE-19	AFJ	12	1	8	5,300 lb.t.+	5.1	1 03[4]	144¼	39 75"	2 800*
	J47-GE-25.	AFJ	12	1	8	5,800 lb.t.+			144¼	00 75"	2 500*
	J53	AFJ									
	J73	AFJ			1	0,000 lb.t.*			147¼		
	J79	AFJ				15,000 lb.t.					
Pratt & Whitney Aircraft Division United Aircraft Corp *East Hartford, Conn.*	J48	CFJ	1	1		7,200 lb.t.+					
	J57	AFJ				10,000 lb.t.*					
	J75	AFJ				15,000 lb.t.*					
	T34	AFP	13	3		5,700 eshp.*		62*	158"	30"*	2,550*
	T52	AFP				8,300 eshp.*					
Westinghouse Electric Corp. Aviation Gas Turbine Division *Philadelphia 13, Pa.*	J34-WE-34	AFJ	11	2	1	3,250 lb t.	4 1[5]	1 06	120"	24"	1,263
	J40-WE-6	AFJ				7,200 lb.t.+			186"	40"	3 000*
	J40-WE-8	AFJ				7,200 lb.t.+				40"	3 500*
	J46	AFJ				6,000 lb t.					
Wright Aeronautical Division Curtiss-Wright Corp. *Wood Ridge, N J*	J65-W-1	AFJ				7,200 lb.t.					
	J67	AFJ				15 000 lb.t.					
	T47	AFP				12,000 eshp.*					
	T49	AFP				10,000 eshp.*					

* —Approximate.
AFJ —Axial-flow turbojet.
AFP —Axial-flow turboprop.
CFJ —Centrifugal-flow turbojet.
Eshp.—Equivalent shaft horsepower
Lb.t —Pounds thrust.

[1] Each power section. T40-A-10 comprises two side-by-side engines using single gearbox.
[2] Advanced version of T40
[4] At 70% cruise power.
[5] Uncowled, minus tailpipe but with tailcone

Military Aircraft Appropriations & Expenditures, 1935-1955

Fiscal Year	ARMY AIR CORPS & U. S FORCE				NAVAL AVIATION				TOTALS	
	Total Approp.[1]	Total Expend.[1]	Airc. Approp.[2]	Airc. Expend.[2]	Total Approp.[1]	Total Expend.[1]	Airc. Approp.[2]	Airc. Expend.[1]	Airc. Oblig & Approp.[1]	Airc. Expend.[1]
1935	$27 0	$30 3			$32 1	$21 0			$60 0	$42 1
1936	45 0	32 0			40 7	23 0			80 3	55 0
1937	38 6	41 1			38 6	26 6			07 2	67 6
1938	58 6	50 0			51 5	30 0			110 4	111 7
1939	71 1	83 0			48 1	47 5			110 2	130 7
1940	186 5	108 2			111 5	40 5			208 1	157 7
1941	6 173 0	605 4			462 3	190 7			2,625 0	705 1
1942	23 040 6	2,554 0			6 189 4	1 008 5			00,229 3	3 017 4
1943	11 017 4	0 381 0			6 252 0	3 847 3			16,570 4	13 230 2
1944	23 580 3	13,087 0			4,583 7	4 493 1			34,230 7	17 577 4
1945	1 010 7	11,287 4			4,000 0	5 130 0			6,011 3	16,497 4
1946	5 420 0	6,775 6	$633 0	$240 0	922 4	N A.	$01 0	N A	464 6	240 0[3]
1947	3 144 4	2,003 0	477.5	370 7	865 7	752 4	307 0	$259 8	785 4	630 5
1948	3 604 4	6 011 2	1 341.5	650 5	749 0	736 1	529 2	108 0	1 870 8	779 2
1949	6 399 6	5 013 6	731 2	003 6	1 338 0	670 0	738 7	310 8	1 469 9	914 4
1950	4 729 8	3,400 2	1 656 0	1 390 1	1 068 4	930 3	013 0	440 0[3]	0 310 0	1,790 1
1951	16 860	6,381	8 134	1 739	4 357	1 031	3 431	588	11 565	2 527
1952	22 726	12 786	11 882	4 000	5 255	1 980	4 333	1,200	16 216	5,200
1953	22 333	15 022	12 685	6,000	4 873	2,500	3 610	1 610	16 610	7,610
1954[4]	11 410	15,681	3 465	6,500	2 322	3,700	1 310	2 400	4 870	8,300
1955	11 206	16,104	2 760[5]	6,700	2 958	0 400	1 987	2 450	4,747[5]	0,300

[1] In millions of dollars.
[2] Air Force only
[3] $142 million withheld by the Secretary of Defense.
[4] Estimated on basis of federal budget submitted to Congress.
[5] Plus $1.3 billion in unobligated 1954 funds.
Sources. USAF, U S Navy

Leading Foreign Jet Engines

Manufacturer and Address	Designation	Type	Compressor stages	Turbine stages	No. of combustion chambers	Max. takeoff power @ sea level	Compression ratio @ max. rpm. @ SL	Specific fuel consumption (lb./hr./lb. thrust or eshp.)	Max. length uncowled and minus tailpipe	Max. diameter uncowled and minus tailpipe	Dry weight (lb.) minus tailpipe, cowling and accessories
AUSTRALIA											
Commonwealth Aircraft Corp. Pty., Ltd. *Port Melbourne*	Nene 2-VH	CFJ	1	1	6	5,000 lb.t.	4.1	1 0	108"	49 6"	1,310
	Avon Mk. 1	AFJ	10	6	8	6,500 lb.t.	6:1	86	126 0"	42 4"	0,058
CANADA											
A. V. Roe Canada Ltd. *Malton, Ont.*	Orenda 8	AFJ	10	1	6	7,800 lb.t.	—	—	121 80"	48"	6 700*
	Orenda 9	AFJ	10	1	3				121"	45"	2 288
	Orenda 10	AFJ	10	1	3	—		—	123"	44.6"	2 700
	Orenda 11	AFJ	10	2	6				121"	45"	2 300
GREAT BRITAIN											
Armstrong Siddeley Motors Ltd. *Parkside, Coventry*	Mamba ASM.3	AFP	10	2	6	1,475 eshp.	8 35:1	86	87 82"	80"	780
	Double Mamba ASMD 1	AFP	10	2	2 cn.	2,960 eshp.	5 35:1	86	70 82"	52 9"	6 106
	Python Mk.3	AFP	14	2	11	4,116 eshp.	6 35:1	90	120"	54"	6 450
	Sapphire ASSa.6	AFJ	10	2	—	8,300 lb t.		96	130"	35"	2 300
	Viper ASV.3	AFJ		—		1,380 lb.t.		—	45 4"	23 3"	365
	Viper ASV 5¹	AFJ	—		—	1,540 lb. t.				23.3"	465
Bristol Aeroplane Co., Ltd. *Filton, Bristol*	Proteus 705	ACFP	12A, 1C	4	8	3,780 eshp.		48	100 0"	39 5"	6,650
	Proteus 765	ACFP	12A, 1C	4	8	4 150 eshp.		46	100"	39 6"	2 925
	Olympus BO1.	AFJ				6 750 lb. t		—	124"	40"	6 530
	Orpheus	AFJ	—		—	—		—		—	
de Havilland Engine Co., Ltd. *Stonegrove, Edgware, Middlesex*	Goblin 35	CFJ	1	1	16	4,500 lb.t.	4 4:1	1 14	60"	50"	1,610
	Ghost 48 Mk. 1	CFJ	1	1	10	4,850 lb.t.	4 1	1 17	112 5"	53"	6 174
	Ghost 50	CFJ	1	1	10	5,000 lb.t.	4 1	1 06	110 5"	53"	6,174
	Gyron	—	—	—	—	15 000 lb. t.*		—	.	..	—
D. Napier & Son Ltd. *London W 3*	Nomad 2	AFP	16	3		2 045³		355	100 0"	66.6"	3 565
	Eland	AFP	10	3	6	3,000 eshp.	— .	558	140 5	36"*	1,575
Rolls-Royce Ltd. *Derby*	Derwent R. D 7	CFJ	1	1	9	3,500	4.1	1 08	84 1"	43"	1 280
	Nene R.N.2	CFJ	1	1	9	5,100 lb.t.	4 2:1	1 06	96 8"	49 5"	1,631
	Dart Mk. 209	CFP	2	2		1 400 eshp *	5 5:1	83	97"	38"	1,000
	Avon R.A.2	AFJ	12	2	8	8 000 lb t.		98	130 23"	41 5"	6,803
	Avon R. A. 3	AFJ	12	2	8	6,398 lb t.		88	102 1"	42 2"	2,240*
	Avon R. A. 7	AFJ	12	2	8	7 500 lb. t.	—	92	102 1"	42 2"	6 450*
	Avon R. A. 7R⁴	AFJ	10	2	8	2 200 lb t.		1 90⁵	117 8"	42 2"	2,060*
	Avon R. A. 3	AFJ	12	3	8	7 000 lb. t.		81	102 6"	42 2"	6,440
	Avon R. A. 14	AFJ	12	2	8	2 500 lb. t.		84	113 3"	41 5"	6,800
	Avon R. A. 16	AFJ	12	2	8	2 600 lb. t.		83	113 3"	41 3"	2 710
	Avon R. A 21	AFJ	12	3	8	6 000 lb. t.		92	102 1"	42 2"	2,400
	Avon R. A. 22	AFJ	12	2	8	7 150 lb. t.		89	103 0"	42 2"	6,242*
	Conway R.Co.2	—	—	—	—	10,000 lb.t.	—	—	—	.	—
FRANCE											
Societe d'Exploitation des Materials Hispano-Suiza *Bois Colombes (Seine)*	Nene	CFJ	1	1	9	6,055 lb.t	4.1	1 06	33"	88"	1,603
	Verdon R-450	—	—	—	—	7 720 lb t.	—	1 07	—	—	2,315
Societe Rateau *La Courneuve (Seine)*	SRA 101	AFJ	10	2	16	7,278 lb.t.	6:8	96	121"	43"	2,256
Societe Nationale d'Etude de Constructions de Moteur d'Aviation *Paris*	Atar 101C	AFJ	7	1	—	6,163 lb.t.	4 5:1	1 0	112"	34 6"	1,650
	Vulcain	AFJ	—	—	—	10 000 lb. t.			— —	45 0"	3 530
Societe Turbomeca *Paris*	Artouste	CFP	1	1	—	280 eshp	— —	88	61 4"	21 4"	185
	Aspin 2⁶	CFJ	1	2	—	793 lb. t.		55	47 5"	20 6"	320
	Marbore 2	CFJ	1	1	—	880 lb. t.	6 9:1	1 15	52 4"	22 3"	288
	Palas	CFJ	1	1	—	352 lb.t.	—	1 29	41 2"	18"	133
	Pimene	CFJ	1	1	—	252 lb.t.	3 8:1	1 06	41 8"	18"	116

* — Approximate.
AFJ — Axial-flow turbojet.
ACFP — Combination axial-and-centrifugal-flow turboprop.
AFP — Axial-flow turboprop.
CFJ — Centrifugal-flow turbojet.
CFP — Centrifugal-flow turboprop.
Eshp. — Equivalent shaft horsepower
Lb.t. — Pounds thrust.

[1] Long-life piloted aircraft version of ASV 3.
[2] Lightweight, medium-thrust unit for Folland Gnat fighter.
[3] A 12-cylinder horizontally opposed compression-ignition engine supercharged by an axial-flow compressor and coupled to an exhaust gas turbine. Power from the C.I. engine and excess power from the turbine are absorbed by a single-rotation propeller.
[4] Fitted with afterburner
[5] Using the afterburner
[6] Ducted fan

AVRO ORENDA axial-flow turbojets in the 6,000-lb thrust category, lined up for delivery from the Malton, Ontario plant.

G.E. DEVELOPS 400-AMPERE GENERATOR TO MEET NEEDS OF NATION'S AIRLINES

A compact new 400 ampere generator requiring only six inches of cooling air over a range of 4500 7000 rpm has been developed by General Electric to meet the needs of the nation's airlines.

First application of the new d-c generator is on the Douglas DC 7. All electric power aboard America's newest airliner is supplied by four of the new 30 volt, 400 amp G E generators.

The new generator (Model 2CM244) has the highest capacity of any wide-speed range commercial unit of its size (6½ inch frame). Resulting from G E's continuous interest in the requirements of commercial airlines, the new equipment offers these *exclusive* features:

- QUICK ATTACH DETACH (QAD) mounting flange permits installation in minutes instead of hours.
- CLEARANCE TYPE SHAFT absorbs engine drive vibrations and reduces spline wear to insure longer life and reduced maintenance.
- SHRINK-RING COMMUTATOR permits higher speeds without commutator distortion to provide greater service life.
- NEW CORED BRUSH, a distinct advance in aircraft brush design, eliminates pre-filming of commutator, improves commutation, and reduces commutator temperature.

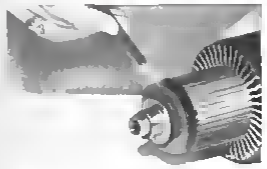
The new aircraft generator also offers these improvements:

1. Silver-plated, cast-bronze brush holder minimizes brush chatter and increases contact efficiency.
2. Solid steel armature binding bands securely hold end turns and prevent winding distortions.
3. Pre-lubricated clearance-type shaft (internally lubricated) provides for increased operating life.

Whether your requirement is a-c or d-c, a single generator, or complete electrical systems, contact your General Electric aviation specialist, or write Section 210-85, General Electric Company, Schenectady 5, New York.

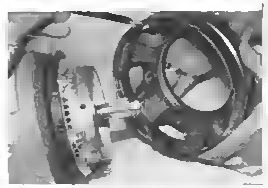
GENERAL ELECTRIC

Exclusive features of new G-E generator on DC-7



SHRINK RING COMMUTATOR withstands higher speeds without distortion to insure long service life.

CORED BRUSH eliminates pre filming of commutator, improves commutation and reduces commutator temperature



QUICK-ATTACH-DETACH mounting flange sharply reduces time required for generator removal or installation.

Airpower Balances on Budget Tightrope

Lean U.K. treasury forces government to hold down defense procurement, push export soles of military and civil aircroft. RAF receives first squadron of Swift F-1s, as B-47s and F-86s still man front lines.

By Nat McKitterick

(McGraw Hill World News)

London—The breathing space in the East-West conflict which Sir Winston Churchill predicted more than a year ago has been a great boon to British aviation.

It has allowed Britain to follow a two-pronged policy on airpower development, compatible with the precarious living this country ekes out these days.

HAWKER HUNTER

On the one hand, procurement of new aircraft for the Royal Air Force has been kept down—only $392 million in fiscal 1953-54 and not much more in the up-coming year. Britain's air chiefs have deliberately postponed placing large orders for aircraft which promise to show marked improvement with more time.

On the other hand, a sizable proportion of Britain's airpower buildup has been turned into a commercial asset. Makers of Britain's famed civil jet transports have official priority equal to the most important military aircraft projects. And exports of both civil and military aircraft are booming. Last year the British exported about $182-million worth of aircraft, split almost 50-50 between civil and military types. At the same time, about $56 million worth of civil aircraft were delivered to British Overseas Airways Corp., British European Airways and to the small fleets of Britain's private operators.

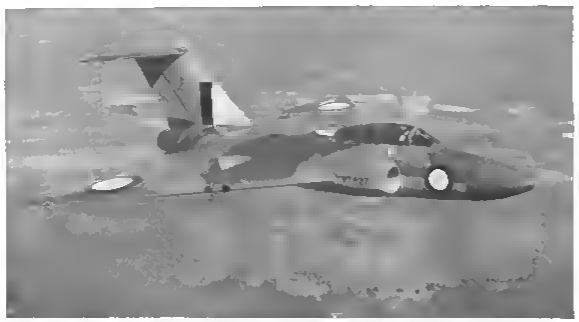
While these figures don't accurately describe the division of labor between military and civil work in the U.K. industry, it is significant that over half the value of completed aircraft delivered last year was paid for by customers other than the RAF.

►Good Economics, Poor Defense—If this is satisfactory economics, nobody here claims it to be satisfactory defense. The front line of defense in the U.K. today is still manned by USAF-flown B-47 Stratojets and Canadair-built F-86 Sabres given to RAF Fighter Command over the past two years.

Military Aviation

Not until recent weeks has RAF received its first home-built sweptwing fighter squadron—Supermarine Swift F.1s. And despite the expected delivery of a small number of Vickers Valiant four-jet medium bombers this year, Britain's very promising strategic air arm won't exist in significant numbers before 1956.

The ultimate targets of the RAF, as set out three years ago when the current rearmament program was started, are still a long way away. When announcing the program, the then Labor government's Air Minister, Arthur Henderson, predicted that in fiscal 1954-55, for the first time, the RAF would outstrip the other British services in its claim on the annual defense budget.



GLOSTER JAVELIN

AVRO VULCAN

But last year's defense cutbacks upset Henderson's prediction. This year's defense budget, which will be announced about the time this is printed, will again show the British Army getting more money than the RAF, and the British Navy not far behind.

►Envy U.S. "New Look"—Understandably, British airmen are not a little envious of the "new look" in U.S. defense policy which clearly establishes the USAF's prior claim on defense funds. Virtually all the arguments that led to the U.S. policy shift have been used here by air-minded British strategists for a long time.

Like the Pentagon, British military planners see the best defense against Russia today in terms of instant and devastating retaliation. Put another way, the British don't yet see any reliable technical defense against enemy missile strikes from the air. In World War II, 1,050 missiles—German V-1s and V-2s—fell on England. Now, almost 10 years later, the RAF would again have to rely on bombing launching sites as the major means of countering even these first products of the missile age.

At the same time, Churchill, like President Eisenhower, is under the strongest sort of political pressure to keep defense spending within bounds. Indeed, only a Churchill could risk trotting out a budget this year that earmarks just a bit more for defense than last year's budget did. The increase reflected in this year's defense budget unfortunately does not stem from new spending on air development. It was made inevitable by Britain's irreducible commitments overseas.

Like the U.S., the British would dearly love to effect these economies by reducing their troop commitments overseas.

In the words of Earl Alexander of Tunis, Churchill's Defense Minister, "My aim is to build up a strategic reserve (in the U.K.) ready to go off to deal with any emergency at any time." Alexander spoke one month after President Eisenhower said virtually the same thing in the U.S.

►Overseas Troops—Reducing troop commitments overseas is far more critical to the development of the RAF than it is to development of USAF.

Today Britain has 15,000 troops in Malaya, 80,000 more in Suez, about two divisions in Kenya, four armored divisions in Germany, and smaller garrisons in such farflung places as British Guiana, Gibraltar and Hong Kong. For a nation which is stretching its economic capabilities to find $4.6 billion a year to spend on all defense needs, these commitments mean an enormous maintenance budget. In fact they mean that the British Army needs and gets more money than the RAF.

►Research Suffers—These troop commit

BRISTOL BRITANNIA

■ BRITAIN

ments put a low ceiling on aircraft procurement for the RAF. More serious, they curtail spending on military research. No research figures as such are printed in Britain's defense budget, but the late Chester Wilmot, Britain's leading writer on military affairs (who died in the Comet crash last January), claimed that less than 10% of last year's defense budget was spent on research. Wilmot figured "only a small proportion" of that 10% was spent on guided missiles.

This year spending will be shifted a little in the RAF's favor—and in the favor of research. But until some of Britain's overseas commitments are liquidated, in one form or other, the RAF's plans will continue to be hamstrung for lack of funds. The issue rests with Britain's diplomats and with the U.S. It is almost certain that the British will follow any U.S. lead in withdrawing troops from such places as Germany and Korea.

▶ **U.S. Aid**—While RAF development is held in check by Britain's overseas commitments, it is also supported to a crucial extent by U.S. aid.

Lockheed Neptunes, Douglas Skyraiders, and North American-Canadair Sabres have been given to the RAF and to the Royal Navy. (Many of the Sabres, incidentally, are grounded in the U.K. for lack of a spares backlog; others are in Germany.)

More important, some $482 million in U.S. money has been earmarked for direct financial help to the British aircraft industry over the past few years. That is a third again more than last year's total RAF budget for the procurement of new aircraft and engines. In one way or another, the RAF's whole production schedule is geared to this aid.

The U.S. has given the U.K. $112 million in machine tools, without which the rather spectacular production program for the Rolls-Royce family of Avon jet engines would not have been possible. U.S. tools, the last of which are only now being delivered, are helping to turn out Avons in five different factories. In a sixth factory, they are helping turn out Armstrong Siddeley Sapphire jets.

Then there is the "offshore" purchase program which has benefited Britain more than any other NATO power. So far, the U.S. has ordered $147-million worth of Hawker Hunter F.1s in the U.K. and $117-million worth of Hunters in Holland (airframes) and Belgium (Rolls-Royce R.A. 7 engines). To replace a shipment of Douglas Skyraiders slated for the British but diverted, the U.S. last year spent $13 million on Hawker Sea Hawk jets (Rolls-Royce Nene), now in squadron

BRITISH CIVIL AIRCRAFT BUILT FOR HOME AND EXPORT SINCE THE WAR

Type	No.	Supplied to
Handley Page Hermes 4	25	BOAC.
Airspeed Ambassador	21	BEA.
Vickers Viking	69	BEA. (only 41 now on strength—rest sold to operators in UK and abroad)
" "	75	Various operators overseas including Egypt (7), Rhodesia (9), B.W.I. (6), India (12) Iraq (4).
Handley Page Marathon	3	Burma
" " "	6	W. Africa
De Havilland Heron[1]	1	Isle of Jersey
" " "	14	Indonesia
" " "	3	Japan
" " "	2	Norway
" " "	4	New Zealand
" " "	9	UAT (France)
" " "	4	Uruguay
" " "	2	Brazil
Percival Prince	2	Tanganyika
" "	2	Venezuela
" "	1	Switzerland
Short Sealand	1	Pakistan
" "	1	Egypt
" "	2	Norway
" "	6	Finland
" "	1	Borneo
" "	1	Dutch New Guinea
" "	2	E. Bengal
Avro Tudor 4	21	BSAA
" " 5	6	BSAA
De Havilland Dove	Over 500 to some 40 countries, including Australia, Burma, Brazil, Argentina, Canada, India, Japan, (4), New Zealand, Sudan, Africa, U.S. (over 50).	
Bristol Freighter	180	Canada, Australia, New Zealand, France, Spain, Saudi-Arabia, West Africa, Indo-China.
De Havilland Comet 1	9	BOAC
" " 1A	10	Operators overseas.
" " 2	12	BOAC
" " 3	3	PAA
" " 3	5	BOAC
" " 3	2	Indian
Bristol Britannia	31	BOAC
" "	6	Qantas (Australia)
Vickers Viscount	41	UK
" "	47	Operators overseas.
Auster Lightplanes	Many hundreds	All parts of world.

[1] Total Herons on order in December 1953: 42

service with the Royal Navy.

▶ **More Help Sought**—Last August, the British approached Washington with a further request. They asked for a financial grant of some $210 million, spread over two years, to make good the production commitments they have already made to NATO defense planners. At this writing, a decision from Washington is imminent. If the request is granted (and there is opposition in the Pentagon), much of the money will be administered as further "offshore purchases" of Hunters or Gloster Javelin delta-wing all-weather fighters.

Despite stories to the contrary, no decision has been made as to who will finally get the "offshore" Hunters produced in the U.K. The U.S. takes legal title to the aircraft when they come off the production line in June 1955, or thereabout. Then the U.S. may allocate them anywhere.

Trying to plan ahead for RAF Fighter Command, the British are anxious to have a decision soon. It is certain that they will get some of the aircraft, if not all of them. Thus, of course, makes the whole "offshore" business equal to a financial grant, something U.S. officials are afraid Congress will object to. But the fact is that its object is to increase Britain's defense contribution, and to that end the RAF needs many Hunters.

The Norwegians want Hunters and may get a few from this source. But only one other country could absorb any large numbers. That is Germany.

The idea of using Hunters to form the nucleus of a German air force is very much alive. The British were led to believe that many of the original Hunters ordered "offshore" in the U.K. would go to Germany. But the whole timing of German rearmament has been put back since then.

▶ **What Our Money Buys**—Is this investment a good one?

Chances are this question is going to be faced pretty directly in Washington this year. Opponents of spending money on European aircraft production are likely to stress two points:

• **Aircraft factories in Britain,** as well as on the Continent, are vulnerable to Russian air attack. This argument is sure to be used this year as NATO tackles its top priority air decision: the picking of a NATO all-weather fighter. The question resolves itself on a choice between the Gloster Javelin and the F-86K. The British argue that it would be cheaper for the U.S. to finance a second Javelin production line in the U.K. to supply NATO nations. They point to the huge expense involved now in assembling F-86Ks at Fiat in Italy.

But other, more telling, political reasons make it highly likely that the U.S. will support the F-86K. Congress is likely to look more fondly on the offshore program if at least one U.S. aircraft is involved. And in Italy politics dictate keeping the Italian aircraft production force intact if possible. Right now Fiat has a small contract to assemble 50 North American-built F-86Ks. Chances are it will be followed with a large contract to build the aircraft completely at Fiat for NATO.

• **One possible interpretation** of the new U.S. defense policy would allocate to America's allies the primary job of policing world trouble areas on the ground. The strategic punch and the mobile reserve would come from the U.S. In this context is it sound to build up European airpower?

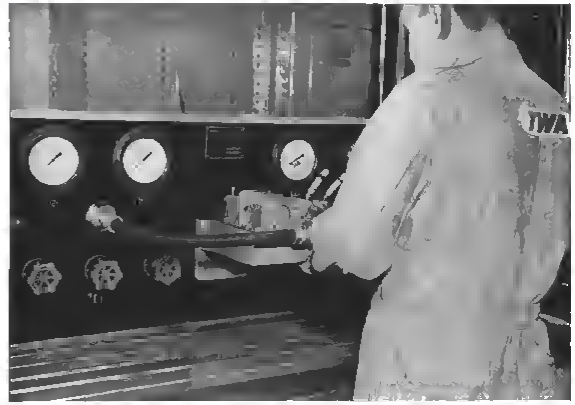
Either of these arguments, or both, taken very far could cripple the hopes of the RAF, now so dependent on U.S. aid. But both the practice and promise of British military aviation today make it extremely unlikely that the U.S. will change its policy here.

First, the fact that the largest aircraft production base in the West, outside the U.S., exists and is producing in Britain today argues strongly that our investment is a good one.

Second, the proven inventiveness of Britain in aviation matters promises many original contributions to Western defense in the months to come.

Production

In many ways British aircraft produc-



Thermostatic control valve, shown under test by TWA technician, controls oil supply to oil cooler. Greer's Oil Radiator Temperature Control Valve Test Stand checks its performance and dependability under low, normal and high temperatures. Same machine also tests controls that operate cowl flaps of reciprocating engines.

Oil cooler being cleaned and tested by Aer Lingus maintenance men. This Greer Oil Cooler Stand sends cleaning fluid through cooler at the rate of two flow reversals per minute. Its tumbling and surging actions insure complete and positive cleaning. A compressed air circuit tests for cooler leaks after cleaning.

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tion is much maligned without cause.

The Avon engine program is a case in point. Production has been so successful that at present, according to one expert, the supply of Avons is almost twice the availability of airframes. There is no engine shortage in the U.K.

The group of companies making the English Electric Canberra (English Electric, A. V. Roe, Ltd., Short Bros., and Handley Page) have delivered upwards of 400 to the RAF so far—the biggest single aircraft production effort in the world outside of the U.S. and Russia. This light bomber has proved itself able to run away from Sabres at altitude in mock combat.

The end of Canberra production is in sight, less than two years hence, with the exception of a new night intruder version, incorporating an even lower-aspect-ratio wing and, probably, two Rolls Royce R.A. 14 jets (10 000 lb.-plus thrust).

Research

If production were all, the skies of Britain would be swarming with Hunters and Swifts at this date. In addition to being ordered late in the game, both aircraft are actually being held up by technical difficulties rather than production. The Swift has suffered from surging in its Rolls-Royce R.A. 7 jet engine and the Hunter, among other things, has yet to have an approved set of dive brakes. Still and all, some

U. K. AERO EXPORTS*

Since the War

Year	£ sterling
1946	14,483,419
1947	25,055,200
1948	26,004,784
1949	34,215,177
1950	34,275,423
1951	41,955,652
1952	43,933,539
1953	**65,227,188

1953 (by months)

January	4,273,483
February	4,467,502
March	5,087,464
April	4,931,009
May	5,494,768
June	7,119,675
July	6,859,934
August	5,284,472
September	5,402,086
October	5,393,018
November	5,306,930

*Includes complete aircraft, engines, airships, balloons and parts and rubber tires (outer covers)

**Annual rate based on first 9 months of year.

(Source: Trade and Navigation Accounts of the U.K.)

BRITISH GAS-TURBINE AIRLINERS
Ordered To Date

COMET SERIES 1 AND 1A ORDERS

Ministry of Supply	2
British Overseas Airways Corp	9[1]
Canadian Pacific Airlines	2[2]
Union Aeromaritime de Transport	3[2]
Air France	3
Royal Canadian Air Force	2
Total:	21

[1] Three lost in crashes. [2] One lost in crash.

COMET SERIES 2 ORDRRS:[3]

Ministry of Supply	1 prototype
British Overseas Airways Corp.	12
British Commonwealth Pacific Airways	3
Japan Air Lines	2
Linea Aeropostal Venezolana	3
Panair do Brasil	4
Air France	3
Canadian Pacific Airlines	3
Total:	31

[3] First delivery this year.

(Options for Comet 2s—UAT (number unspecified); CPA—1; BCPA has option for three Comet 2s or 3s.)

COMET SRRIES 3 ORDERS:[4]

Pan American World Airways	3 (option for 7 more).
British Overseas Airways Corp	5 (option 5)
Air India	2
Panair do Brasil	— (option 2)
Total firm orders:	10

[4] First delivery 1956.

GRAND TOTAL COMET ORDERS· 62 AIRCRAFT

(In addition various operators have options on 100 additional Comet Series 2s and 3s)

VISCOUNT 700 SERIRS ORDRRS:

Ministry of Supply	[1] 2
British European Airways[2]	38
Air France	12
Aer Lingus	4
Iraqi Airways	3
Trans-Australia Airlines	6
Hunting Air Transport	3
Trans-Canada Air Lines	15
Indian Government	2
British West Indian Airways	3[3]
Fred Olsen (Norway)	2
Total	90

[1] Including 12 Viscount 802s. [2] Now negotiating.

BRITANNIA ORDERS:

Ministry of Supply	1
British Overseas Airways Corp	33 (plus an option for 2 more).
Qantas Empire Airways	6[7]
Total	40

[7] *Letter of intent to purchase signed.*

(In addition, the possible sale of 51 additional Britannias to at least seven other airlines is under negotiation.)

70 Hunters are flying or near first flight today.

All told the British aircraft industry, now 230,000 men strong, has been expanding at a 2,000-men-a month clip recently, and most of the newcomers are production personnel.

▶ **New Developments**—Harder to illustrate because of the security laws, are the new British air developments in the mill which promise to make an original contribution to Western defense. Visitors to Farnborough over the last few years have seen a few hints, and those here this year will see some more.

As one top RAF officer put it "We feel it is absolutely fundamental that we do our own strategic thinking."

▶ **Three Vs**—Top priority among RAF planners today goes to Britain's three medium bombers, the delta-wing Avro Vulcan (four Bristol Olympus jets), the Handley Page Victor (four Armstrong Siddeley Sapphires) and the Vickers Valiant (four R-R Avon R.A. 14s). The shape, alone, of the "Three Vs" indicates an original approach to the problem of strategic bombing.

"Flexibilty" is a word RAF policy makers use a lot these days. It applies with force to the three Vs. All can take off from virtually any military airport in the Commonwealth. Indeed, short takeoff runs were a primary consideration in their design (AVIATION WEEK Oct. 19, 1953, p 14).

Ranges are estimated between 5,000 and 7,000 miles. (Flight Refueling, Ltd., equipment is being built into all three.) As lone raiders, using speed, darkness and weather for protection, they make very promising nuclear bomb carriers. They inspired RAF Bomber Command's famous slogan, "A rapier, not a bludgeon."

▶ **Hit Them First**—This year a second major concept, high on the list of RAF priorities, will come to light. RAF officials lately have been talking about all-weather fighter defenders capable of hitting enemy bombers over or near their home bases. Armed with missile armament, these intruders would, ideally, try to intercept enemy bombers on their initial climb.

First British aircraft with this mission promises to be the show stealer at Farnborough this year. Produced by English Electric, it is a sweptwing twin-jet fighter, research for which is being carried out by the Short Bros. S.B. 5 experimental model with manually adjustable wings. The English Electric aircraft will have not much less than 70 deg. sweep. Production versions are likely to show English Electric's continued reliance on Rolls-Royce for engines.

▶ **Missiles Under Wraps**—When the fog of security lifts, Britain can be ex-

pected to have much to offer Western defense chiefs in the missile line. Both industry and RAF spokesmen have led observers here to look for an accent on air to air and air-to-ground missiles.

Because money is so tight, the RAF is always extremely reluctant to order anything that promises marked improvement within a reasonable amount of time. Largely for this reason, Britain hasn't a single missile in production today.

Minister of Supply Duncan Sandys summed up the missile situation this way last fall: "The first phase is the design and construction of prototypes. The second is the carrying out of trials and the introduction of such modifications as the trials show to be necessary. Thirdly, there is the manufacturing stage. . . . It is the trials stage which we are now entering with several rocket weapons." Trials are going on at Australia's giant Woomera range.

▶ **Boundary Layer Control**—There are many other British military developments lying behind security. One avenue of study currently causing a lot of excitement here as in the U.S. is boundary layer control, or the use of jets in lift. In a speech this winter, Sir Frederick Handley Page saw in this direction a development "even more profound in its effect than the introduction of metal aircraft in the 1930s."

"The introduction of jet propulsion," said Sir Frederick, "led to a new design philosophy which aims at the integration of propulsion and lift production." Large quantities of air, he pointed out, are available from the engine, which can be tapped to effectuate some form of boundary layer or circulation control.

Sir Frederick claimed that basic research so far indicated that substantial improvements in performance, due to drag reduction or lift augmentation, can be obtained through bypassing of power to control the boundary layer or circulation, and hence the lift of the wing. "Alternatively," he concluded, "the whole problem of takeoff may be revolutionized by the incorporation of jet thrust into the lifting system."

Shortly after this speech, one of Britain's leading engine designers told members of the British aviation press that they should "push" the idea of researching boundary layer control instead of spending money for newer and longer runways.

▶ **Spending Their Own**—One of the healthiest signs in British aviation is the fact that many, if not most, British aircraft companies spend some of their own money pursuing military research projects not underwritten by the government. Part of this spending is motivated by the fact that the competition

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between companies for the very limited government research money is so intense. By starting off on their own, the companies hope to get a jump on their neighbors.

• **De Havilland** financed its new Gyron jet through initial bench tests before the government stepped in with an order. The Gyron, sure to be in the 20,000-lb.-thrust class, is a fighter engine, which will probably see the air first in a new Naval version of the D.H. 110 all-weather fighter.

• **Fairey Aviation,** for a not untypical example, has sunk $10 million of its own money into military research since the war, most of it on guided missiles and related work. And Fairey is a tiny company by American standards.

• **Short Bros.** last year financed privately the Sherpa research project, to test the possibilities of the aero-isochnic wing form. (While 80% of Short's assets are owned by the government, only one director is a civil servant.)

• **Folland.** Probably Britain's most enterprising aviation capitalist today—in the military field anyway—is W. E. W. Petter, designer of the English Electric Canberra and now managing director of Folland Aircraft, Ltd., a big subcontractor to the industry. Petter is using his own money to build two prototypes, generally referred to as the F. O. 141 Gnat. These are Britain's first light fighters. The first should fly in the fall.

The Gnat's design gross weight is only 6,000 lb., but with it Petter promises to give a day-fighter performance in the class of the Hunters and Swifts. (Production Gnats will have a thinner wing than the prototype and are quoted as being designed for speeds to Mach 1.05.)

Bristol is building Petter an engine—the Orpheus—of around 5,000 lb. thrust. But the prototypes will fly on Armstrong Siddeley Viper jets of less than 2,000 lb. thrust.

Petter's big selling point is the Gnat's low price—about $70,000 each on a quantity order. This is hardly a third of the cost of Hunters and Swifts. Petter thinks this is the answer to the problem of making defense and economics agree in western Europe. He has presented his case strongly to NATO officials in Paris.

Thoroughly committed to Swifts and Hunters, RAF top brass has turned a deaf ear to Petter's arguments for the Gnat so far.

What is Petter sacrificing to get his performance at that weight, the RAF wonders. After all, Hawker Hunter designer Sydney Camm accented weight saving in the Hunter to the limit of his ability—so much so that he had plenty of headaches finding enough

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range and room for such things as dive brakes.

But the British Army, worrying whether there will be enough Hunters and Swifts to provide adequate ground support, and the British Navy, intrigued with the idea of Gnats on its baby flattops, are showing interest. And Petter has high hopes that somehow U.S. financial backing can be found for the Gnat, although it surely must be predicated on a British order first.

Civil Aviation

Other persons exuding confidence in British aviation are the makers of Britain's famed civil jet transports.

There are now almost 200 firm orders for de Havilland Comets, Vickers Viscounts, and Bristol Britannias. All, save three Comet 3s ordered by Pan American, are for customers outside the U.S.

Considering that there are hardly more than 1,000 mainline transports operating in the free world outside of the U.S., the British have made a good start. Most important, virtually all of their customers are converts from U.S. equipment.

▶ Vickers Viscounts—Vickers, with its

EMPLOYMENT IN THE UNITED KINGDOM'S AIRCRAFT INDUSTRY

Employment in the "Manufacture and Repair of Aircraft" reached 227,400 at the end of October, an increase of 2,500 on the previous month.

	Males	Females	Total
1949			
June	130,700	21,300	152,000
December	131,200	25,900	158,100
1950			
June	128,000	21,000	149,000
December	131,300	22,000	153,300
1951			
January	134,100	23,900	157,900
February	135,800	23,500	159,300
March	137,000	23,000	160,000
April	138,000	23,000	161,000
May	137,240	24,250	161,500
June	138,800	24,800	163,600
July	139,300	24,700	164,000
August	141,100	25,100	166,200
September	143,500	25,600	169,100
October	145,300	26,700	172,000
November	147,300	27,000	174,300
December	148,300	27,200	175,500
1952			
January	151,900	27,600	179,500
February	150,600	26,500	177,100
March	152,700	25,900	178,600
April	156,200	25,900	182,100
May	158,570	26,730	185,300
June	164,900	30,200	195,100
July	165,400	30,300	195,700
August	167,900	30,900	198,800
September	168,300	31,000	199,300
October	172,300	30,900	203,200
November	173,900	30,600	204,500
December	179,200	31,000	210,200
1953			
January	177,000	31,000	208,000
February	178,500	31,900	210,400
March	180,700	31,700	212,400
April	182,400	32,000	214,400
May	184,400	32,300	216,700
June	185,900	32,400	218,300
July	186,900	32,500	219,400
August	188,800	32,700	221,500
September	191,300	33,000	224,300
October	194,000	33,400	227,400

turboprop Viscount, stole the show last year and is likely to do so for most of this year. So far, 90 Viscounts, worth more than $55 million, have been sold. Vickers has delivered 18 to British European Airways and six to Air France. BEA has 10 more Viscount 701s coming and Air France six more. Between them these two operators will have Viscounts operating into every European capital and many Middle East centers this year.

Aer Lingus will have its three Viscounts around mid-year, will operate them between Dublin and London and from Dublin to Manchester, and Amsterdam. By fall, Trans Australia Airways will have Viscounts running Down Under on intercity services. And perhaps before the end of the year, Trans Canada Air Lines will have the first of their 15 Viscounts flying into New York.

Early this year Vickers will announce details of its Viscount 802, a dozen of which BEA has ordered. The 802 is a revision of the 801 which BEA ordered just a year ago. With the same payload (66 to 82 passengers) and the same gross weight (65,000 lb.), the Viscount 802 is designed for economical operation up to 900 miles, whereas the 801 was a specialized aircraft designed for high-density, 300 mile stage lengths. The greater flexibility in cost per ton-mile of the 802 over the 801 is made possible by the fact that Rolls-Royce has continued to find both new power and new economies in the Dart turboprop.

Darts now are giving 1,400 shp. plus 365 lb. of thrust for BEA in service. In their first six months of operations with BEA, Viscount 701s showed a cost per capacity-ton-mile of about 43 U.S. cents. Already Vickers has announced new versions of the Dart with 9% savings on fuel consumption and 8% increase in speed. By the time the 802s get flying, the Dart should show even more economy and power—building up from the present 300-plus-mph cruising speed to about 350 mph in the 802s.

▶**De Havilland Comet**—In contrast to the Viscount, the past year has been the year of the troubles for the de Havilland Comet. Orders for Series 2 and Series 3 Comets moved up very little over the year, as customers held off to see what would have to be done as the result of mishaps with the Comet 1s.

Takeoff accidents with the Comet 1s at Rome and Karachi have led to a redesigned leading edge on the Comets 2 and 3, in order to give more lift on takeoff.

BOAC has introduced 50 mechant

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cal modifications in the Comet 1, most of which will be incorporated in the Comets 2 and 3. Both operator and manufacturer are sparing no expense in learning them hard lessons.

But still unanswered at this writing are the causes of the two major BOAC Comet 1 disasters near Calcutta last May and off the island of Elba in January. Both of these aircraft broke up during climb for reasons which are still shrouded in mystery. Questions are bound to persist on such points as the adequacy of the Comet's fully power-operated controls or the behavior of kerosene fuel under certain conditions of temperature and pressure. Probably only accident-free hours in service will ultimately restore full confidence in the Comet.

Following its policy of pushing production and introducing modifications on the line, DH has moved ahead with both the Series 2 and the Series 3 Comets. The Series 2, with four Rolls-Royce Avon Mark 502 jets giving upwards of 7,000-lb. thrust, has almost completed its initial flight tests. To show its stuff, the Comet 2 prototype in January made a nonstop flight from London to Khartoum. The figures were impressive. Distances, 3,080 miles; average speed, 481 mph.; payload, 10,500 lb. equivalent (capacity), fuel load 6,900 gal. DH test pilot John Cunningham landed at Khartoum with 1,120 gal. of fuel left. The stated range of the Comet 2 is about 2,600 miles.

This summer the eagerly awaited Comet 3 prototype (four Rolls-Royce Avon R.A. 16 jets of 9,500-lb. thrust) will make its first flight. Operationswise, the Comet 3's main advance is boosting capacity from 44 passengers in the Comet 2 to 58 passengers.

▶ **Reverse Thrust**—But there will be some technical changes, too. Most interesting will be de Havilland's reverse-thrust mechanism designed to give extra braking to the 140,000 lb. Comet 3.

Chances are the mechanism will appear on one of the first three Comet 3s, but not on the prototype. It has been described as working after the fashion of an eyelid, closing off the tail of the jetpipe, and directing the efflux through guide vanes in a generally downward and forward direction.

De Havilland is the strongest of Britain's aircraft builders financially. The company has virtually staked its future on Comets. It would be a pessimistic observer indeed who didn't predict that the Comet will revive this year with a vengeance.

In any case, civil jet operators years hence will owe many millions which they will never have to pay for the knowledge BOAC and de Havilland are

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BRITISH MILITARY AIRCRAFT EXPORTS

On Order Or Delivered 1953
(Numbers given in brackets where available)

Aircraft	*Purchaser*
Armstrong Whitworth Meteor N F 11	France [2nd order]
Auster A O.P	South Africa
" Aiglet	Arabia
" Cirrus Autocar	Australia.
Avro Lancaster	France [59]
" Shackleton	South Africa
Boulton Paul Balliol	Ceylon
Bristol 171 Mk 50	Australia [2nd order]
de Havilland Chipmunk	Indonesia
" " Devon	New Zealand
" " Vampire fighter	Chile, Finland [3], South Africa
" " Vampire trainer	Iraq, Norway, Portugal, South Africa, Sweden
" " Venom N F 2	Venezuela, Sweden
English Electric Canberra B 2	Venezuela [12],
Fairey Firefly T T	Sweden [2nd order making total of 12].
" Gannet	Australia [40]
Gloster Meteor T.7 & F.8	Brazil [70]
" Meteor F.8	Israel, Syria [14]
Percival Pembroke	Southern Rhodesia [4].
" Provost	Southern Rhodesia.
Short Sealand	India [10], East Bengal [2].
" Sunderland	New Zealand [16].
Supermarine Attacker	Pakistan.
Westland S-51	Yugoslavia *

*"Offshore" order.

learning the hard way now.

▶ **Bristol Britannia**—Up until the second prototype crash landed last month, it was expected that this year the Bristol Britannia turboprop would join Britain's other two aces in becoming a practising carrier. But this was the aircraft earmarked to do Bristol's certificate of airworthiness tests. (The first prototype was not built to a production standard.) The tests are delayed now for some months until Bristol gets its first production model flying.

Now it will be the summer of 1955 before BOAC gets the first of its 15 Mark 100 Britannias into service. They will start on BOAC's West African runs before entering the North Atlantic tourist service, carrying 92 passengers between London and New York.

The Mark 100s are powered by four Bristol 705 turboprops, giving 3,780 eshp each. Only 15 will be built. Subsequent Britannias—for BOAC and Qantas Empire Airways—will be Mark 300s with four Proteus 750s giving 4,150 eshp. (Both BOAC and Qantas have also ordered Mark 250 versions, same as 300s, only rigged for half passenger, half freight loads.)

Tooling for production of Mark 300s has already started at Short Bros., Belfast. Ultimately, Short and Bristol will each produce 25 Britannias a year. This investment indicates that there is more than speculation behind Bristol's claim that there are 51 new orders (in addition to the 40 already placed) in the advanced talking stage.

Canadair plans to build a maritime reconnaissance version of the Britannia in Canada for the RCAF. Curtiss-Wright Turbo Compound engines will most likely be the choice for the Britannia MRA's since the mission will require prolonged low-level cruising. Proteus turboprops eat up too much fuel for this.

As Britain's first entry on the North Atlantic routes, the Britannia is definitely the plane to watch in the near future. The Britannia promises to do the London-New York run in not much over 13 hours, carrying a payload in excess of 25,000 lb. Fuel used would fall somewhere under 60,000 lb.

New Transports

All this year and next, you'll be hearing a lot about the second generation of British turbine transports—the generation most likely to equal the first U.S. civil jet projects in range, speed and capacity. The competition among advocates of big turboprops, bypass jets and turbojets is fierce.

There are three big British projects:

- De Havilland's design for a "Comet 4."
- Bristol's design for a "Super Britannia."
- Vickers V-1000 military jet transport prototype (with its civil version, the VC-7).

Bomber-builders A. V. Roe and Handley Page like to talk about their civil versions of the delta-wing Avro Vulcan and the crescent-wing H. P. Victor. Known respectively as the Avro Atlantic and the H.P. 97, these ideas exist now in the form of two impressive models. But neither is a likely starter in the big race. Avro might eventually come up with a serious civil type since the Hawker Siddeley Group, of which Avro is a member, is alone among big British companies in not having any civil projects.

▶ **Vickers 1000**—Of the three serious projects, powerplants are going to spell success or failure. "After all," says George Edwards, managing director and chief designer of Vickers' Aviation Division, "what's an airframe but a few hunks of bent metal, hitched together with their edges rounded off."

Edwards is championing the 13,000-lb. thrust Rolls Royce Conway bypass jet, four of which will power the Vickers 1000 prototype. As far as complication goes, Edwards tells visitors he regards the Conway as "proved." He figures he'll get up to 10% savings on fuel consumption over comparable turbojets and around 50 mph more speed than comparable big turboprops.

Most important, with a prototype order in hand, Vickers will be first off the mark. The V-1000 should fly in 1955. So far there is only an order for a prototype from RAF Transport Command. But both BEA and, lately, BOAC are wooing Vickers ardently. BOAC is anxious to beat the Americans with a nonstop trans-Atlantic jet carrier. Dreamer Peter Masefield, chief executive of BEA, summed up his ideas on the V-1000 in a pseudo-poetical vein: "The 100 passenger 'Victory Class' aeroplane taxis out (at London), lands, time in Rome due little more than two hours ahead, then on to Athens and Cairo and back to London the same day—4,500 miles and five stops in a reasonable aircraft day." Masefield sees all this within 10 years.

Edwards confidently predicts his military prototype will double for a civil prototype—to be called a VC-7. Edwards isn't anti-turboprop by any means. And that's not just because he's had so much success with the Rolls-Royce Dart in his Viscounts. Edwards has on the drawing boards a "Vickers 900" project, which probably will use

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Rolls' newest turboprop venture, an engine in the 4,000-eshp range. The Vickers 900 design hasn't been firmed up, as far as is known. BEA, which is interested, wants a high wing configuration, but that depends on selling the idea to other (export) customers.

▶ **Bristol on Turboprops**—Down at Bristol, Dr Stanley Hooker, head of Bristol's Engine Division, scoffs at those who see no future in a big turboprop. Hooker, master-mind of the 10,000-lb.-plus Bristol Olympus turbojet, is marrying his Olympus with his current Proteus turboprops to produce an 8,000-eshp turboprop destined for the second generation of Britannias. He gives Edwards his 50-mph. lead on speed, but claims the great economies of the turboprop will make up for that. The Olympus plus Proteus turboprop will actually be rated less than 8,000 eshp to give Hooker the ability to offer constant power from sea level to 25,000 ft.

As for complexity, Hooker claims that will go with time. He says that nothing like the money spent on researching turbojets has been devoted to researching turboprops. By 1958, when Hooker's new engine should be flying, he thinks turboprops will be a lot simpler.

▶ **Comet Successor**—Nothing is known of de Havilland's thinking about Comet 3 successors other than the fact that a design—or rather designs—exist. According to sales manager Frank Lloyd, DH will base its sales argument on a belief that there is and will be a place for "first-class" or luxury air transport. This will be the place for the admittedly more expensive turbojet.

From the meager data released on DH's powerful Gyron turbojet, it seems the company is putting simplicity and efficiency in turbojet design in the forefront. If turbojet economics can be made competitive, the Gyron or its derivatives may be the engine to watch.

If the pace of transport development in the U.K. is to be maintained, money must be found to keep all these projects alive. DH alone is saying now that it will use its own money to build a "Comet 4" prototype.

BOAC will probably underwrite the Britannia developments if the first Britannias turn out as well as they promise. And if mobility is to play any part in RAF thinking, money must eventually be granted to the beleaguered RAF Transport Command. Besides ordering the V-1000 prototype, RAF Transport Command has ordered only one new type of aircraft—20 Blackburn & General Beverley freighters.

DC-3 Replacements

In a minor key, several British companies this year will be touting private

ventures designed to do the work of the indestructible DC-3. Despite a torrent of pessimism about the market for DC-3 "replacements," British makers are going ahead with prototypes. They cite India and Africa as places for a new aircraft with limited capacity.

• **Handley Page**, with its HPR-3, is furthest along. Two prototypes are building. The HPR-3 is a piston engined aircraft—powered with four Alvis Leonides Majors. It will carry three tons, or 36-44 passengers, 1,500 miles at 220 mph.

• **Aviation Traders, Ltd.**, a large subcontractor, is entering the field with its Accountant, powered by two Rolls Royce Dart turboprops. The Accountant has a maximum payload of 6,600 lb., can cruise at around 310 mph. for 920 miles. The aircraft is so arranged as to be able to carry 15 stretcher cases with attendants, 33 passengers, or two cars or equivalent freight. Prototype has just started.

• **Percival and English Electric** have comparable projects in the design stage, but no details are available. English Electric's design calls for an Armstrong Siddeley Double Mamba turboprop installation. The company has applied to the British Air Registration Board for a ruling as to whether this could be considered equivalent to a twin-engined installation. ARB is impressed with the idea.

Helicopters

Rumor has it—and a well founded rumor it appears to be—that the three British services this year will finally place a quantity order (200 or so) for a British helicopter. If so, the only logical candidate is the Bristol 173.

• **Bristol**—The 173 is a 16-passenger copter with a still air range of 214 miles and a cruising speed of 138 mph. Its gross weight of 13,500 lb. is lifted by two three-bladed rotors powered by two Alvis Leonides Major engines. To relieve loads on the rotors during forward flight two sets of stub wings are mounted fore and aft on the fuselage.

The 173 this year went through extensive tests on an aircraft carrier of the Royal Navy. At the time, its use as an anti-submarine weapon was suggested. British European Airways is using a few 171s to research its intercity helicopter plans in the U.K.

• **Fairey**. Most interesting helicopter research project in the U.K. is the Fairey Rotodyne jet. Still two years away from first flight, the Rotodyne will be the first to carry Britain's turbine tradition into the helicopter field. The prototype, underwritten by the Ministry of Supply, will be designed for 40 passengers and baggage and a cruising speed

■ BRITAIN

around 150 mph. It will be powered by two Napier Eland turboprops. Fairey is already thinking in terms of 60 passengers and cruising speeds up to 200 mph for production versions. An interim project, the Gyrodyne, incorporating the Rotodyne's rotorhead, will fly shortly.

• **Westland.** Westland, with the Sikorsky license in the U.K., is building S-55s for the RAF and the British Army this year for the first time with British engines—Alvis Leonides Majors.

• **Saunders Roe** is marketing the little Skeeter helicopter, developed from Cierva, Ltd., patents.

• **Percival** has a helicopter project, called the P.74, designed to apply a gas generator to helicopter propulsion.

Naval Aviation

The Royal Navy this year will probably show off two new fighters.

• **Vickers Supermarine** Division soon should announce first flight of the production version of the Vickers 508 twin-Avon fighter which appeared at Farnborough two years ago. Orders for the sweptwing fighter have been placed.

• **Appearance of the D.H. 110** in naval markings at Farnborough last year tipped off the future development of that all-weather fighter. DH is building more 110 prototypes with folding wings. Speculation has it that the production version will use the Gyron turbojet.

Last year the Navy's 17 month wonder, the Short Seamew, made its first appearance—17 months from design conception to first flight. Powered by an Armstrong Siddeley Mamba (it may have a Double Mamba someday), the Seamew is the forerunner of "light fighters" to come. It is designed for hunter-killer operations with NATO escort carriers. Because of its cheap construction, Short has high export hopes for the Seamew among NATO nations. Price: more than $140,000.

So far the Royal Navy has had less than good luck with its aircraft. Only last year did the Westland Wyvern fighter get into service, its Armstrong Siddeley Python turboprop having given great trouble with surging. No more than 50 were built. The RN's first jets, the Vickers Attackers, are already being supplemented with the very sleek but straight-winged Hawker Sea Hawks.

And the Navy's super-priority anti-submarine aircraft, the Fairey Gannett, has been coming and coming and coming for months and months and months. This year, it is confidently predicted, the Gannett will arrive in service about two years late. Half a dozen or more production models of the double-Mamba-powered fighters are flying now.

SE 5000 BAROUDEUR

Offshore Buying Props Ailing French Industry

By Ross Hazeltine
(McGraw-Hill World News)

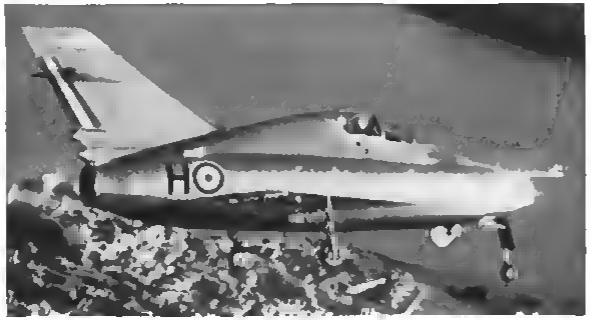
Paris—The French Air Force is fast growing into a major element in the defense of Western Europe. But this has not brought prosperity to French plane builders. On the contrary the aircraft construction industry has posted storm warnings of troubles it fears will affect the whole future of French aviation.

The buildup of the French Air Force during the last three years has been accomplished largely with American equipment delivered under the U. S. aid program. French industry has played a relatively minor role, and the industry's great problem today is simply lack of orders.

More than a year ago France launched a long-term program to replace American equipment in the FAF with planes designed and built in France. The U. S. has contributed importantly to this program with an $86-million offshore procurement order for Marcel Dassault's Mystere interceptor. But still the replacement program is proving a costly burden on the slim financial resources of the state.

▶**Budget Gap**—Plane builders say Air Ministry orders for aircraft are too small and too subject to revision, postponement or cancelation to give the industry a chance of operating efficiently—or even maintaining its present facilities. Government officials reply that France has a chronically unbalanced budget and simply can't devote more funds to aircraft construction.

This gap between what the government can afford and what the aircraft industry needs is the basic problem of French aviation.



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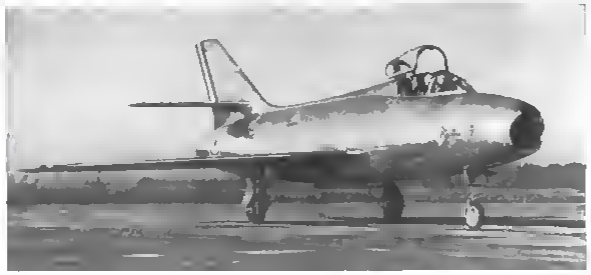

DASSAULT MYSTERE IVB

Industry Potential

The French aircraft industry employs some 63,000 workers—33,000 in airframe construction, 16,000 in engine plants and 14,000 in aviation equipment. Measured by the numbers of workers employed, about two-thirds of the airframe and engine industries is nationalized.

If all the manufacturing facilities of the industry were fully utilized, it is esti-

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mated that France could produce 1,200 to 1,400 fighter planes—like the Mystere or the F-86—each year. The industry claims it must have orders for 600 to 800 planes annually to achieve minimum efficiency. Prospects are not bright that more than half that minimum level of production can be attained.

▶ **Airlines Buy Little**—Commercial airlines have not to date been important buyers of French planes. A recent count showed that all European airlines owned a total of 615 planes. Of this total 58% were American, 38% were British and only 4% were French—12 four-engined Deux Ponts, three four-engine Sncaso Armagnac and 10 Sncaso two-engine Bretagnes.

French sales to airlines may pick up some in the near future. Air France has signed a contract to buy 24 Hurel-Dubois H.D. 32s, a two-engined plane with a high-aspect-ratio wing, which is just now getting into production. Industry officials hope some foreign carriers, too, will place orders for the H.D. 32.

The French Air Force is now, and will remain for at least the next few years, the one big buyer of French-built planes. But FAF's capacity to buy is strictly limited by the general political and economic conditions which shape the national budget, and a close look at the present structure and organization of the FAF gives little reason for optimism.

French Air Force

About 3,000 planes of all types now carry the colors of the French Air Force. The French have about 500 planes in Indochina including four transport squadrons with DC-3s, five fighter squadrons with Bearcats, two light bomber squadrons with B-26s and one reconnaissance squadron.

In Europe and North Africa, France has a total of 38 squadrons equipped with F-84s, Dassault Ouragans and Sncase Mistrals (French version of British Vampire). All but eight of these squadrons are pledged to NATO and operate under the command of Allied Air Forces Central Europe.

▶ **$800 Million to Spend**—To operate, equip and maintain this force the Air Ministry this year has a budget of $800 million (470 billion francs). Of this total about one-third, $250 million is for aircraft construction and is being spent principally for the production of four planes—the Mystere IV, Sncaso Vautour, Nord 2501, Fouga Magister.

• Mystere IV, equipped with a Verdon engine (Hispano-Suiza version of the Tay) developing 7,720 lb. thrust, will begin to go into squadron service in September of this year. The Verdon

engine later will be replaced by an axial flow Atar 101E built by the nationalized company Snecma. This engine will develop about 7,300 lb. thrust and an afterburner will add about 20%. This version of the plane is called the Mystere IV-B and is expected to go into squadron service in about two years.

• **Vautour.** The 1954 budget also provides funds for the construction of 79 Sncaso Vautours, a two-engine ground support plane. The Vautour will have Atar 101B engines with 5,280 lb. thrust, which give it enough speed to crack through the sonic barrier in a shallow dive. The first Vautours will begin to go into squadron service about the middle of 1956. The present Vautour order is considered only a first slice and will be supplemented with funds to be provided in future budgets. The French also hope the Vautour will attract attention abroad. They point out that within the NATO air forces only the American B-26 and the British Canberra are designed for light bombing and ground support missions of the type the Vautour will specialize in.

• **Nord 2501.** The third plane in production is the Nord 2501, a two-engine transport. The Air Ministry has placed a new order for 60 of these planes. Production of this plane is now six or seven a month, and the first of them will begin to go into squadron service within a few months.

The French believe the Nord 2501 is particularly well-suited for use as a tactical transport in Indo China. It can carry seven tons over distances less than 600 miles, and its configuration makes it suitable for dropping heavy loads by parachute.

• **Magister.** A fourth plane, the Fouga Magister, will go into production this year. The Magister is an advanced trainer powered by two Turbomeca Marbore engines with 880 lb. thrust. A total of 100 of these planes have been ordered, and deliveries will begin in about 18 months.

► **New Candidates**—Two other French military planes—the Baroudeur and the Trident—now still in the testing stage, have shown promise and may be produced with next year's funds.

• **The Sncase Baroudeur,** powered by an Atar 101C with 6,160 lb. thrust, takes off with rocket assist from a tubular steel carriage and lands on skids. Tests so far have given better than expected results. The Baroudeur can land on ordinary plowed ground, on a sandy beach or on grass. A pre-production series of five has been ordered.

• **The Sncaso Trident** is the other prototype being tested. The Trident is a small light plane designed for the defense of small critical areas. It is powered by two Turbomeca Marbore en-

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gines with 880 lb thrust each, and carries tail rockets which are expected to raise its top speed to Mach 1.6. The plane probably will make its first flight with rocket power next spring.

The Future

These planes are the newest weapons in the arsenal of French airpower. With the funds available to them, French airmen figure they can bring these new planes into service at the rate of about 300 a year. That is about all the nation's economy will allow, and it is also about all that is needed to maintain the FAF at its present level.

But this figure represents only one third to one-fourth of the present production capacity of the French aircraft construction industry. So unless exports and sales to French airlines can be greatly increased, the industry is in for bad times which will force reorganization of the nationalized companies and a big reduction in industry capacity.

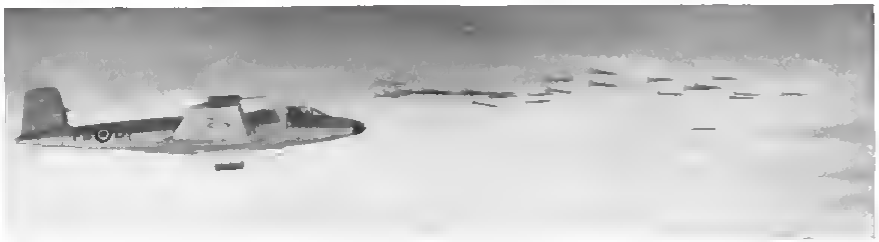
►**Three Plants Down**—First steps in the direction already have been taken. Within the last six months three important aircraft plants have been closed permanently. Sncan was forced to close two of its six factories, and Morane Saulnier shut down one plant.

The industry, naturally, is doing its best to resist this trend. With government support it has organized a committee to study foreign markets, arrange exhibitions of French planes abroad and advise French manufacturers on export sales techniques. It also is urging larger appropriations for aircraft construction and the imposition of some limitations on purchase of foreign planes by French airlines.

But nowhere in the industry is there any great optimism that these efforts can succeed fully enough to solve the problem. The U. S. government could solve the problem by greatly increasing its offshore procurement orders and supplying French planes to other Allied nations.

►**Salvation in EDC?**—The brightest hope for the future of the French aircraft industry rests with the projected European Defense Community. If the EDC treaty should be ratified this spring, the French believe it will open to them a big and profitable new market. Of the six EDC nations—France, Germany, Italy, Belgium, the Netherlands and Luxembourg—only France has in existence now a big, skilled and equipped aircraft construction industry.

To French airmen it will be bitter irony if nationalistic opposition to EDC in the French national assembly succeeds in killing the treaty, and so strikes the blow that may well knock out half the industry's present capacity.



AVRO CANADA CF-100 CANUCK

Airpower in the North

Canada Rushes Defense Net, Aids NATO

Lion's share of defense funds goes to RCAF expansion in Canada and abroad; aircraft and engine production is small but growing.

Toronto—Largest slice of Canadian defense expenditures in the past few years has been for the Royal Canadian Air Force.

Results of this policy are now visible with a number of RCAF squadrons on active duty at bases in Great Britain, France and West Germany, with progress being made on the Canadian continental defense system, establishment of first domestically based Canadian jet fighter squadrons, and completion of a number of large training and supply bases across Canada.

Industrially the results of the policy are also noticeable with jet aircraft and engines coming off assembly lines at plants in eastern Canada and new jet aircraft being ordered.

RCAF

Although few details have been released, the RCAF reports progress in the past year on the early warning and ground control system for continental defense. Some of the units were in operation late in 1952, and construction work on other units was completed at end of 1953. Radar system is operated jointly by RCAF and U.S. air services throughout northern Canada.

Canada is also planning to develop a new system of radar warning developed at McGill University, a system which is cheaper in manpower and equipment than the conventional radar warning system now shared with U.S.

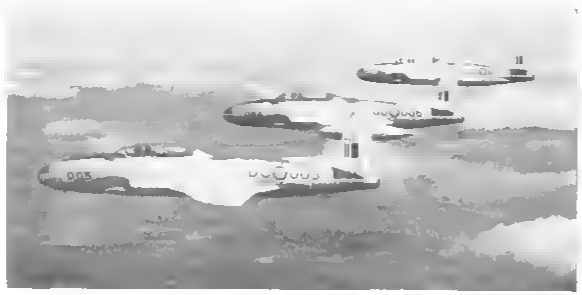
RCAF during the past year opened ground observer filter centers across Canada, as part of its continental defense establishment. First Canadian-based jet fighter squadrons using the Canadian made and -designed CF-100 twin engine jet fighter were established in 1953 at North Bay, Ontario, along with a training base for crews for these aircraft. A number of other Canadian bases are being equipped with CF-100 aircraft.

▶ **Contribution to NATO**—Overseas, Canada now has 12 Sabre-equipped squadrons, based at Langar and North Luffenham in England, at Metz and Marville in France, and at Zweibrucken and Baden-Soellingen in Western Germany. These are part of Canada's contribution to NATO. Canadian air staff overseas includes both men and women. Practically all aircraft used in the overseas squadrons were flown over during 1953.

Canadian air forces took part in a number of operations with the USAF in north Atlantic and northern Canadian areas during the past year, perfecting the joint operation. The RCAF also developed its coastal squadrons, its air transport service, and its search and rescue groups. It took delivery in 1953 of two British de Havilland Comet jet transports for its Transport Command, the first Comets to be used on this continent.

▶ **Bases and Men**—Numerous new bases were built or started during the past year as part of RCAF's $400-million construction program. These included two huge supply and overhaul bases outside Toronto and Edmonton, as well as permanent buildings for personnel and new hangars for larger aircraft. Runways were extended at many airports for jet fighters, and training bases were completed.

The first T-33 Silver Star jet trainers made in Canada by Canadair Ltd., Montreal, were delivered to training bases. Aircrew trainees from nine countries are now undergoing training at Canadian bases, Portuguese and Turk-



CANADAIR T-33A SILVER STARS

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ish trainees joining those of Great Britain, Norway, Denmark, the Netherlands, Belgium, France and Italy in 1953.

As part of its continental defense plans, RCAF this past year began training personnel in ground defense in case of paratroop or other enemy attacks on local airfields.

Recruiting was reported as continuing steadily throughout 1953. Estimated strength at end of 1953 was 43,000 officers and men, about 5,000 more than at end of 1952.

Production

As 1953 ended the Canadian government announced plans for new orders for new aircraft being placed with Canadian aircraft companies, thus making the decision to keep the Canadian aircraft manufacturing industry in active operation. Canadian aircraft plants during 1953 made aircraft not only for the Canadian military services, but also for those of the U. S. and other countries of the North Atlantic Treaty Organization.

► **$400 Million From Aviation**—The aviation manufacturing industry in 1953 accounted for about three-quarters of the entire revenue from aviation in Canada.

In 1952, aviation ranked ninth among Canadian industries, and last year set a new peacetime record amounting to about $400 million. Of this, over $300 million was accounted for by manufacturers of aircraft and components, and repair and overhaul services, according to estimates of the Air Industries and Transport Assn. of Canada.

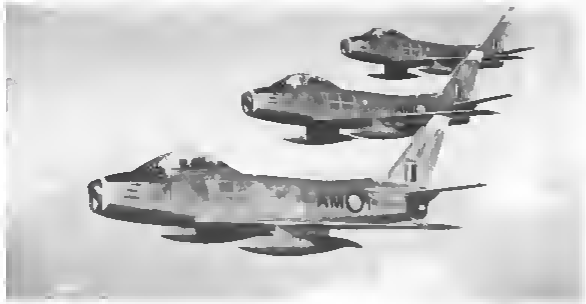
Bulk of the $300 million revenue was for defense work, including payments on contracts totaling $504 million let in 1952.

► **New Planes**—At year-end the government announced plans to produce a new fast fighter, the CF-105, by A. V. Roe Canada Ltd. This delta-wing aircraft is expected to have a speed of 1,200 mph. a range of 1,500 mi., to be armed with rocket missiles, and to have two new jet engines to be made by A. V. Roe Canada. A prototype is to be ready by about end of 1955.

The other new plane to be produced is the Grumman S2F antisubmarine aircraft, which will be made under license in Canada by de Havilland Aircraft of Canada, Ltd., mainly for the Royal Canadian Navy. Orders are expected to be placed for 100 of the aircraft to start, with 150 more at a later date, according to unofficial estimates.

Slated for early production in Canada is the British Bristol Britannia for

■ **CANADA**



CANADAIR F-86E SABRES

RCAF. This is to be made by Canadair, Ltd., with certain modifications from the commercial Britannia made in Great Britain, including, it is said, a new wing, elongated main fuselage, redesigned tail assembly and use of U.S. built Wright engines. A prototype will probably be built this year, with an order for 50 of the aircraft expected initially.

▶ **Manufacturing Lineup**—Canada's aviation manufacturing industry is still small. Four companies are building aircraft, three are making engines, and about a dozen are the principal overhaul and component manufacturing firms in the country. There are several hundred smaller companies and plants whose main business is not the aviation industry, making components and parts for the manufacturing plants.

Most of the industry is centered in eastern and central Canada, and is controlled by British or American parent companies.

• **A. V. Roe Canada, Ltd.**, is located at Malton, Ontario, a suburb of Toronto, and has about 10,000 people working in the aircraft plant, another 5,000 in its jet engine plant. Currently Avro is building the CF-100 Mark 4 for the RCAF in undisclosed numbers, as well as the Orenda jet engine for both the CF-100 and the Sabre F-86E being built at Canadair. Orders have been completed on the CF-100 Mark 3, which has been equipped with rocket missiles.

Research work is being done at the plant on advanced type aircraft, including what is believed to be a "flying saucer" type of gyroscopic jet-powered single seater fighter. No official information is available on this research job which is very hush-hush at the plant and in government circles.

Work is also progressing on new jet engines to power the new delta wing CF-105, while production of the Orenda engine is on schedule. No figures have at any time been released as to production of the Orenda engines since the early stages of its production.

• **De Havilland**, at Downsview, another suburb of Toronto, is continuing with production of its single-engine Beaver and Otter aircraft. The Beaver was used by the U.S. in Korea and other

Major Canadian Aviation Plants

	Floor Space (sq. ft.)*	Employes*
AIRCRAFT		
A. V. Roe Canada Ltd. Toronto	1,500,000	10,000
Canadair Ltd. Montreal	2,000,000	11,000
Canadian Car & Foundry Co. Ltd. Fort William, Ont.	700,000	1,600
De Havilland Aircraft of Canada Ltd. Toronto	600,000	2,000
ENGINES		
A. V. Roe Canada Ltd. Toronto	1,000,000	5,000
Pratt & Whitney Aircraft Ltd. Montreal	350,000	1,200
Rolls-Royce of Canada Ltd. Montreal	60,000	400

* As of December 1953

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locations as the L-20. In the fiscal 1953, ending last Sept. 30, the company delivered 181 Beavers and 16 Otters, the latter for the RCAF. A total of 555 Beavers had been sold since the company began production of this postwar-designed Canadian freighter. It is now being used in 29 different countries, including the Falkland Islands where the 500th aircraft is in use.

Most of the Beavers are equipped with Pratt & Whitney engines, but for sterling currency countries a new Beaver was produced in 1953 powered with the British Alvis Leonides engine. Sales for 1953 totaled about $15 million.

De Havilland Aircraft of Canada also sells and services the British de Havilland Dove airliner, the de Havilland Comet jet airliner, the de Havilland Ghost jet engines which power the Comet, and overhauls a number of RCAF aircraft and the General Electric J 47 jet engine.

• **Canadair, Ltd.**, is the major aircraft plant at Montreal. American-owned, Canadair is building the Sabre F 86E and the T 33 Silver Star jet trainer. It is reported that about 1,000 Sabres were produced by late 1953 for Canada, Great Britain and the U. S.

Definite orders for civilian aircraft are being sought, but none are at present known to be headed for production. The company services and overhauls the North Star DC-4M, with which it started postwar production for the RCAF and Trans-Canada Air Lines. While present plans call for possible production of the Bristol Britannia under license for the RCAF as a transport, there is likelihood that this aircraft may also be produced for civilian purposes at this plant.

• **Pratt & Whitney and Rolls-Royce** at Montreal are building aircraft engines. The former is building aircraft engines for the Harvard trainer, and Rolls-Royce is building Nene turbojet engines for the T-33 jet trainer.

• **Canadian Car & Foundry**, at Fort William, Ontario, at western end of Lake Superior, is completing an order for Harvard trainers, and was building components for the T-36 trainer when that order was canceled in the latter part of 1953. It may start production of another trainer for the U. S. government.

These are the major aircraft and engine manufacturing plants in Canada. Together they employ about 31,000 people, and form the nucleus for a larger aircraft manufacturing industry in Canada.

Civil Transport

This year Canadian airlines will use larger and faster aircraft, start domestic

■ CANADA

air tourist services, inaugurate new domestic and international routes and begin all-express and all-freight services with specially built cargo airliners. In 1953 Canadian airlines expanded their operations both at home and internationally and waged a major battle to break government monopoly of certain domestic air services.

▶ **New and Faster**—Both government-owned and privately owned airlines will have new and faster aircraft in use in 1954.

• **Trans-Canada Air Lines**, government-owned service, is starting new daily transcontinental services later this year with Lockheed Super Constellations, eight of which have been ordered. Some of these will be used on TCA's trans-Atlantic service which now uses Canadian-made North Star DC-4M aircraft in tourist-rate service.

TCA will also take delivery later this year of the first British Vickers Viscount turboprop aircraft to be used on this continent, for use on heavily traveled Montreal-Toronto services, Montreal and Toronto services to New York, Toronto services to Cleveland and Chicago.

For cargo service, TCA early this year began using British Bristol Freighters, three of which were ordered. Air cargo rates were reduced by 30% at beginning of 1954.

• **Canadian Pacific Airlines**, which in 1953 began its Vancouver-Mexico-Lima service with DC-6B airliners, now has a 12,000-mi. service in operation from Hong Kong via Tokyo to Lima, as well as service from Australia to Vancouver. Late this year it will take delivery of the first de Havilland Comet 2 jet airliners to be used by a North American carrier. Three have been ordered at cost of about $4.5 million for use on the long-stage intercontinental routes, Honolulu to Vancouver, Vancouver-Mexico City-Lima. A fourth Comet 2 is to be delivered in 1955.

During 1953, CPA applied for an all-cargo service from Montreal-Toronto via northern Manitoba to Vancouver, but was turned down.

▶ **Other Services**—The government also had a number of applications for expansion of regional intercity passenger scheduled services by small carriers towards the end of 1953. Decisions are pending, and will have an effect on further expansion of Canadian airline operations. Some of the carriers also asked for permission to operate tourist-rate services. TCA began domestic tourist-rate services in February of this year.

An increasing number of U.S. non-scheduled charter air services were licensed by the Canadian Air Transport Board for operation into areas throughout Canada. Many of these operators will carry passengers and freight for mining and exploration companies, as well as tourist traffic.

The Canadian government plans to review with U.S. civil aviation authorities the opening of more international routes between the two countries to two carriers, one from each country. In addition to such new routes, TCA will open a number of new domestic services in 1954.

▶ **Good Year**—Canadian airlines had a good year in 1953.

During the first half, the latest period for which complete figures are available, Canadian airlines flew 433,400,000 revenue passenger-miles and 5,869,000 revenue ton-miles.

Canadian Pacific Airlines in the first 10 months of 1953 carried 197,000 revenue passengers, flew a total of 7,703,200 miles, flew 138,640,260 revenue passenger-miles, and 1,526,589 revenue ton miles, in addition to 560,044 airmail ton miles.

Trans Canada Air Lines in 1953 carried 1,300,000 revenue passengers, a new record, and a total of 30,600,000 revenue miles on domestic and international routes. TCA in 1953 flew 6,200,000 airfreight ton-miles, 1,630,000 air express ton miles, and 5,300,000 airmail ton-miles. —James Montagnes

Airpower in Japan

Plenty of Talk, Not Much Action

By Alphens W. Jessup
(McGraw Hill World News)

Tokyo—Taking inventory of Japan's airpower at the start of 1954, one totals up lots of interest, excitement, plans and dreams in the aircraft industry, but practically no physical airpower.

The single exception is the rapidly developing Japan Air Lines Co., which has completed 27 months of successful domestic operations, and last month began scheduled international operations. This exception uses American equipment in the air and on the ground.

Military airpower lags far behind, and way back of the limited hopes of last year. The aircraft industry has suffered accordingly, although dreams and enthusiasm have brought about reorganization of the major prewar aircraft producers. Until they have a real market, however, little can be expected. And the market can only come from military requirements in this part of the world.

► **Air Planning Group**—Not until last fall was an air planning group created within the National Safety Board (Japan's equivalent of the Department of Defense). This group has just been encouraged by Prime Minister Yoshida's announcement that it will soon become the Third (or Air Force) Staff. Further encouragement comes from a provision in the new budget for the fiscal year beginning April 1 of 8.1 billion yen ($20 million) for this air force, the first direct provisions.

The planning group sets as its first target the training of an instructor group. The USAF has promised the assistance of an 80-man training team which will begin working with the Japanese at Hamamatsu Air Base in April. The initial aircraft to be used will be North American T-6s (on loan from the Far East Air Force), and Beech T-34s (a part of which will be purchased out of budget funds and part to come from loan sources). The planners hope that some T-28Bs may be made available, but they have been advised that the shortage of this aircraft probably makes this impossible.

Later in the year, probably around January 1955, the planning group believes some pilots will be ready for transition into the Lockheed T-33. Again it hopes these can be made available by FEAF.

The alternative to loans from USAF and FEAF could come from the Mu-

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tual Security Agency. As yet, little is known about what the equipment split will be in MSA aid for Japan. On the air side, no one has indicated whether the aid will be in a form which would encourage Japanese production of aircraft or simply in the form of equipment procured elsewhere and delivered to Japanese forces.

▶ Industry's Role—The Japanese industry has had its hopes partially fulfilled with the recent signing of a contract between Lockheed and Kawasaki Aircraft Co. for the manufacture of F-94 Starfire interceptors and T-33 trainers.

Kawasaki also will repair and manufacture jet engines under a deal being worked out by Lockheed and Allison Div. of General Motors.

There is no doubt that the Far East Air Force favors such an arrangement, and that it would welcome a similar one with North American to build the Sabre in Japan. North American has a tentative agreement with Shin Mitsubishi Heavy Industry Co.

The question asked here is how one can expect a sound defense base in Japan or elsewhere in the Far East without some production in the area. None of the Title 3, Asian MDAP countries (Korea, Formosa, Philippines, Indo China and Thailand), can undertake such manufacture for years to come.

▶ "No War" Clause—The Japanese are concerned that they may be led down a rose-covered lane to disaster by present U. S. pressure with regard to Japan's defense forces. In the first place the "no war" clause, which Gen. MacArthur wrote into the constitution which his staff prepared for Japan, stated an ideal situation for an ideal world in which Japan might live. The people by and large welcomed this after the long hardships of wartime austerity and the destruction which U. S. airpower wrought through the major cities of the home islands.

Since 1950, U. S. authorities have sought revocation of the effect of this clause. But policy has been dominantly concerned with ground forces and limited coast-guard-type naval forces. Currently, Ambassador Allison must press for Japanese government acceptance of the U. S. desire for a 348,000-man defense force, primarily foot-soldiers. There isn't a ghost of a chance that the Japanese will accept this goal.

Japanese with some conception of the strategic position of Japan are convinced that a 348,000-man infantry isn't going to defend Japan nor is a 1,348,000-man infantry going to. They note that well over two million men under arms were unable to defend the home island from defeat in World War II.

Also, they refer to the reverse situa-

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tion of Great Britain at the start of World War II. Germany's armies rolled across Europe to the English Channel with little trouble, but were unable to invade England because the Luftwaffe was unable to gain control of the air over the Channel and over Britain.

▶ Defense Phases—Top planners in the National Safety Board told AVIATION WEEK that there are two phases to Japan's defense:

- Defense in the air.
- Convoy defense on the sea, to bring in safely the food Japan needs.

They state that only a defense of the air over the Sea of Japan can protect Japan. They are aware that the major threat—Russian—controls a large, modern jet air force which partly encircles Japan.

Present lag in airpower developments stems from the failure of Gen. MacArthur to include a provision for air forces within the original National Police Reserve which was established in the fall of 1950. He included ground and maritime units only. Gen. Ridgeway, when he succeeded Gen. MacArthur as SCAP was too concerned with the Korean situation to pay much attention to the Japanese problems.

▶ Gen. Clark's Role—Things speeded up when Gen. Mark Clark took over as far east commander from Ridgeway. Gen. Clark apparently wanted to win here the battle over Army control of tactical aviation which he had lost in Washington; some observers say. He pressed upon the Japanese safety forces the inclusion of liaison aviation which he hoped would be expanded into Japan's army-controlled air force. Reliable informants in the Far East Command Headquarters told AVIATION WEEK that Clark ignored orders from Washington that he was to take Gen. O. P. Weyland, Far East Air Force commander and senior air officer in the Far East, to all discussions with Japanese authorities on military aviation.

Some army officers have passed the word that Japan's incipient air force is the army aviation now operating in the National Safety Corps. True it has attracted many first line Japanese pilots, but solely because it provided the only flying available in Japan. It has none of the equipment nor any of the tactical doctrine necessary to defend Japan in the air against a Communist air attack. It is simply an army aviation section capable of providing artillery spotting and taxi service.

Currently, there has been no official change in the U. S. position. Emphasis still is placed upon ground forces. One man asked: "Are we to use our bayonets against JF 28s?"

▶ Policy Decisions—Informed U. S. ob-

servers say that apparently only a National Security Council decision could get the Japan air program underway and that so far there isn't the slightest indication that any decision is about to be made.

The two important policy decisions are:

- Can Japan shift its emphasis from ground forces to air forces?
- Will Japanese industry be encouraged with MSA assistance and orders in order to create a necessary industrial support base in this part of the world?

The five-year goal of the Japanese National Safety Board planners is a 1,300 plane air force, including 500 to 600 jets, mostly F-86s and F-94s with the necessary complement of T-33s. No bombers are included in their program. Other requirements include some transports and anti-sub patrol craft, as well as light trainers and liaison aircraft. Numbers are unspecified at this time.

The hope is that all types will eventually be built in Japan, but they are not counting on production at this time. The manufacture of modern jet aircraft requires a capital outlay which no company in Japan can undertake. So the bulk of the combat types must depend upon Japanese government or outside assistance.

▶ **Mitsubishi**—The aircraft section of Mitsubishi has been handling overhaul work for the U. S. Air Force for several months, working on the B-26, C-47 and C-46. It is negotiating for F-86 airframe overhaul and will have an assistance agreement covering this work with North American. Further plans for overhaul of the General Electric J47 are underway, according to Iwataro Nakagawa, aircraft section manager.

Recently, Mitsubishi was certificated by the U. S. Civil Aeronautics Administration for the overhaul of Pratt & Whitney R2000 and R1830 engines. Another Mitsubishi enterprise is the assembly of Sikorsky S-55 helicopters for the Maritime Safety Board.

Mitsubishi had no advantage over most other Japanese aircraft manufacturers, in that its aircraft section was not split up by the occupation-sponsored deconcentration procedures.

▶ **Kawasaki**—Kawasaki Aircraft Co. was split into three organizations, and was reconcentrated only at the beginning of last month. The firm, however, has made at least as much progress in recovery as Mitsubishi, and in some ways is further along. It has designed and built its own four-seater lightplane, the KAL-1, and is working on a trainer version which it claims will be similar to the Beech T-34. It also makes a 240 hp. engine for this aircraft.

Under a tieup with Bell Aircraft, Kawasaki will manufacture the 47-D helicopter. The first was completely assembled from imported parts. After the 15th ship comes off the line, Kawasaki expects only engine and rotor will be imported.

The National Safety Corps (the operating or combat command under the National Safety Board) has ordered six helicopters. Orders are pending for the KAL-1 and the trainer.

A temporary agreement has been reached with Lockheed covering aircraft overhaul on the T-33, F-80 and F-94, some of which are now being put through the Kawasaki facilities from FEAF units. Included in the agreement is overhaul of the Allison J33 and J35 engines.

▶ **Nakajima-Fuji**—Another important manufacturer seriously divided by the occupation, was Nakajima. This firm has recently been reorganized as Fuji Heavy Industries Co. It has a technical tieup with Beech for the production of the T-34 Mentor. The first 50 will be imported knocked-down for assembly in Fuji's Utsonomiya plant. From the 51st unit, Fuji plans for complete production in Japan. One of the company's vice-presidents now is negotiating with Continental for the engine manufacturing rights.

Besides the trainer, Fuji expects to receive orders for civilian versions of the Beech airplane, as well as orders from Formosa.

Beyond this the company has no firm plans. The North American and Lockheed tie ups with Mitsubishi and Kawasaki appear to have sewn up Japan's fighter requirements for some time to come. The country, with limited resources, probably must concentrate on a few basic aircraft for the necessary defense jobs. So Fuji is considering concentration on guided missiles.

Handicapping Fuji is the long occupation of the newest and best Nakajima factories by the U. S. Army. Repeated requests for the return of the facilities, now called Camp Drew, have been ignored by the U. S. Army.

Prewar Nakajima made over 100 DC-2s and DC-3s. During the war it sent advisers to the Showa Aircraft Co., which continued to make transport aircraft for the Japanese military forces.

▶ **Other Manufacturers**—Showa is doing no manufacturing at present, but it would like to renew its connections with Douglas.

Shin Meiwa Industry Co., successor to the former Kawanishi Aircraft Co., the last of the old Big Five, has been manufacturing auxiliary fuel tanks for FEAF, as have several other manufacturers. It has no other business, but is reported to have had some conversa-

tions with Republic Aviation

Nippon Jet Engine Co was founded last year at government insistence and with government capital, to explore jet engine manufacturing possibilities It was feared that much capital would be wasted if Japan allowed all manufacturers to undertake engine development Participating in the company are Mitsubishi, Fuji, Kawasaki and the Ishikawajima Heavy Industries Co, which is exclusively interested in engines

It is known, however, that some of the participants are dissatisfied with this arrangement and would like to undertake direct contact with American or British engine makers

West Germany

Aviation Marks Time Till EDC Ratification

By Gerald W. Schroder
(McGraw-Hill World News)

Bonn—Until the Western allies ratify the Eastern Defense Community pact or grant Bonn special permission of some type, aviation in Germany will remain more or less at a standstill. This applies equally to civil aviation, aircraft production and the projected German air force.

'Lufthansa'

Officials of the proposed German airline still hope to have their first plane in the air sometime this spring, if . . .

The big "if" in the way of realizing plans for the new 'Lufthansa" is the continued delay in ratification of the European defense community. Should the EDC treaty not come into force by spring or summer, Lufthansa officials hope that the three Western powers—the U. S., U. K. and France—can come to an agreement which would let the Germans fly their own airline even thought EDC has not been ratified.

▶**Passed Delivery**—The problem of letting the Germans fly their own planes became increasingly acute in the last month, since Lufthansa was scheduled to receive the first of four purchased Convair 340s by the end of February. The German group had to turn the plane down, and Union Carbide and Carbide Corp. picked it up. The Germans feel that the Allies should now grant them the right to fly, without waiting for EDC.

"Plenty of precedents exist," Lufthansa officials say, "You returned the whole field of aviation safety to us, as well as that of airport administration. If we can't import our planes now and

fly them, what are we going to do with them?"

This statement crystallizes the predicament in which the Germans find themselves today. The "AG fuer Luftverkehrsbedarf" is the Cologne-based organization which will eventually grow into the new Lufthansa. This organization purchased the four Convair 340s at a unit price of $650,000 each, plus an estimated 40% of the unit cost for parts and reserve material for each plane. These planes were to be delivered by this spring and to be used on European routes.

The company has also purchased four Lockheed L-1049E Super Constellations at a unit cost of $1.7 million, plus 40% of the unit cost for parts and reserves, and an additional 15% of the unit cost for special installations ordered by Lufthansa.

Payment for these purchases will be in U. S. dollars. No details are given on terms of payment, but it is understood in Germany that Lufthansa received extremely favorable, long-term credits from the manufacturers. Lufthansa officials feel that both Convairs and Lockheeds will serve them adequately for at least a decade.

"We admire British courage in flying Comets, but we still feel that we selected the right type of plane for our operations."

▶ **Lufthansa Participants**—The company is now capitalized with DM 25 million (about $6 million). Largest shareholder is the federal government, but a number of prominent West German banks and business firms are also represented.

Among these are Daimler-Benz, Farbenfabriken Bayer, Robert Bosch, Telefunken, Siemens & Halske, AEG, and Brown, Boverie & Cie.

The board of governors of the company is composed of the following individuals: Dr. Max Adenauer, son of the German chancellor, Dr. Kurt Weigelt, Dr. Kurt Knipfer, Prof. Leo Brandt, Prof. Edmund Frohne, Dr. Arnulf Klett, Werner Kreipe, Dr. Heinz Oeftering, Helmut Alt, Dr. Herbert Culmann, von Engel, and Adolf Kummerniss.

It is probable that the company will be recapitalized at around DM 80 million sometime this year.

▶ **Fleet Plans**—Final goal of the Lufthansa will be a fleet of around 24 planes, half of which will be used on transoceanic flights, the other half on the European net. It is not certain at this point what type of planes the Germans will buy to complete their fleet. Future types may be of European make, rather than American, but the Germans realize there will not be

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German made planes for many years.

Lufthansa officials hope to start their first European flights by July 1. Convair 340s will fly from German cities to London, Paris and Zurich. A final decision on whether to fly to Madrid or Rome is still pending. Lufthansa plans also call for up to six weekly flights to North America by summer 1955, with an estimated yearly passenger total of 28,000.

Lufthansa's headquarters will remain in Cologne, while the fleet's home base will be in Hamburg where the city government recently appropriated DM 20 million for construction of necessary buildings and installations.

▶ **Training Program**—While waiting for the political green light, Lufthansa is busy training its personnel. Four German pilots, all of them prewar Lufthansa captains, went to England last December to undergo a 10 weeks' training course at Air Training Service at Hamble. The youngest of these pilots is 43, the oldest 47 years of age. At the end of this course, the German pilots will receive British licenses.

Three German instructors are also attending this course as "observers." This group is made up of one technician, one meteorologist and one safety expert. At the same time, 21 Germans are now being trained in Cologne as engineers, radio operators and navigators.

Within the last year, the total Lufthansa staff grew from 40 to a total of 200 individuals, and will probably jump to 350 within the next few months. It is obvious that, once the legalistic obstacles have been removed, the Germans will be airborne within a matter of weeks.

German Air Force

Plans for the establishment of the new German air force are well advanced. Although most of the details are still secret (and the whole project depends on ratification of EDC), the following outline is reliable.

The new German air force will consist of 20 groups: 10 fighter-bomber groups for technical ground support, five fighter groups, and five groups composed of transport, reconnaissance and liason planes, including helicopters.

▶ **1,500 Planes**—The German air force, once completely established, will number about 1,500 planes. The Germans will also get a navy air arm, but this will be so small that they speak of it with embarrassment, if at all. It will include 24 long distance reconnaissance planes and 30 helicopters for anti-submarine and rescue missions.

No decision has been made as yet on the types of planes to be used,

where they will be obtained and whether they will be purchased by the Germans or be given them on a sort of EDC or NATO lend-lease arrangement. The Germans are anxious, of course, to get the very latest models. It is probable that at least the fighter planes will be U. S. models, but consideration is also being given to British and French types.

▶**Age Creeps Up**—The German air force, including mechanics and other ground personnel, will number about 80,000 men.

Training these forces will be a major problem for Germans.

If the European Defense Community does not come into being within a year or two, few of the ex-Luftwaffe pilots will be young and healthy enough to form the backbone of the new air force. If EDC became a reality this spring, however, up to 30% of the pilots needed for the new Luftwaffe could be drawn from the ranks of World War II pilots, German sources say. The names of these pilots have been compiled in Bonn and the men are ready to start training at a moment's notice.

The other 70% of the future pilot force—youngsters who are new to flying—would receive their basic training in Germany and other EDC countries.

The question of airfields suitable for jets will also become a problem for the new Luftwaffe. Some old German army fields, not now in use, may have to be enlarged and modernized. The Germans may also have to share some of the present airfields now assigned to NATO forces.

▶**Three Years to Build**—It would be idle to expect the German air force to bolster Western defense immediately after EDC is ratified. It will take at least 15 months after EDC ratification to get the first combat-ready group into the air, and it will take between 2½ to three years before a new Luftwaffe is completed.

Bonn officials do not feel that the German aviation industry will be ready and able to contribute materially to the build-up of the German air force for at least two years after EDC is ratified. Even then, the German aviation industry will not be able to build military aircraft.

Planning for the new Luftwaffe is now in the hands of ex-Luftwaffe colonels Richard Heuser and Werner Panitzki. Both men are experienced staff officers with considerable combat experience in World War II.

Aviation Industry

Nothing new can be reported from the German aviation industry. As the

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years go by without EDC ratification, industry leaders feel that they are slipping farther and farther behind the rest of the world in such matters as research, capable designers and a trained industrial force.

▶**Aero Union**—In a spurt of optimism, the "Aero Union" was formed last year by Daimler Benz, Focke Wulf, Dornier, Heinkel and Messerschmidt. Aero Union had hoped to build planes in Germany, under license from U. S. firms, for the new Lufthansa. The project, for obvious reasons, fell through and Aero Union has reverted to a state of resigned inactivity.

In the meantime, the industry is turning increasingly to the production of other goods. Heinkel is busy making automobile parts for Auto-Union and Tempo. Dornier is making looms. Focke Wulf produces gliders, and Messerschmidt sewing machines and three-wheeled "auto-rollers."

Gliding

Each year brings an increase in the popularity of gliding in Germany. Recently, West Germany's Aero Club reported a membership total of 45,000, of whom, about 28,000 are qualified glider pilots. Over 150,000 glider take-offs were made from 200 fields in 1953.

Top glider manufacturers in Germany are Focke Wulf, Wolf Hirth, Alex Schleicher, F. W. Schmetz, and the Espenlaub Flugzeugbau.

Most prominent promotor of gliding in Germany is Miss Hannah Reitsch, who took a lightplane off a Berlin street under Russian artillery fire during the seige of that city and is one of the few Germans to see Hitler in his Berlin bunker before his death.—**Gerald W. Schroder.**

Italy

Aviation Falls Short Of Earlier Promise

(McGraw-Hill World News)

Rome—Unsettled political and economic conditions both here and abroad have combined to smother earlier hopes that 1953 would be a signal year in the rebirth of Italian aviation.

▶**Best-Laid Plans**—The Rome Government had officially proclaimed its intention of placing at the disposal of the aviation forces 1,000 first-line planes, a plan had been prepared by civil aviation authorities that, at a cost of $50 million over a three-year period, would have marked the first step towards placing the airlines services in a position matching the possibilities of the country.

The aeronautic industry had acquired new energy. The few surviving factories were completing the first mass production of the training planes that were to assure the revival of Italian aviation. At the same time they were rapidly equipping themselves encouraged by the first NATO offshore procurement contracts, for producing and assembling F-84 parts in the south and F-86 parts in the north.

The design of new training planes, and the preparation of new models for light transports and jet fighters were engaging the time of the best known Italian engineers, encouraged in their work by the revival of government orders and by the hope of securing a share on the future plans for European rearmament.

▶**Gone Aft Agley**—But this sudden revival of enterprise and of hopes gradually gave way as the year advanced. The changed attitude was brought about by new political and economic conditions both at home and abroad characterized by the gradual loss or at least postponement, of what had seemed to be the immediate prospect of the revival of Italian aviation.

The political elections of June 7, when the de Gasperi government fell, produced a political situation differing widely from the previous one, and this has not failed to exert an influence on aviation plans.

In the first three years of the Italian rearmament program the scanty means available had been concentrated on land forces, with a view to promoting the formation of the largest possible number of efficient divisions for immediate use and to absorb the large supplies of ground weapons sent by the United States and Canada.

The strengthening of the air forces was to have started July 1, 1953, and part of the special appropriations made for the army was to have been transferred for this purpose. But the new government which took office after July 7 did not confirm the special appropriations. So Italian aviation for the fiscal year 1953-54 had at its disposal only some $140 million dollars—less than the funds allotted the previous year and $70 million below the minimum on which the Italian aeronautics officials had counted for starting the execution of their plans.

▶**Partial Fulfillment**—It is not, therefore, surprising that under these conditions it has only been possible to carry out partially the limited plans for 1953.

Of the 27 groups of first line aircraft which were to have been formed in 1953, only 19 have been completed, 12 of them supplied with jet planes—F-84 Thunderjets and Vampires (a hundred of the latter were built in Italy).

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In the case of the infrastructure program only 60% has been carried out, though the part referring to the military airfield program, financed by NATO, will be executed in full.

▶ **Industry Suffers**—Under these circumstances of reduced financial means, the sudden advent of a considerable number of modern American jet planes has created further difficulties for the Italian industry.

The upkeep of a squadron of modern American jet planes costs a good deal of money, and so the funds that had been intended to finance the preparation of new designs and construction in Italy have to a large extent been absorbed for the utilization of the aircraft received from abroad.

Italian authorities are now pursuing, within their scanty means, the objective of equipping the Italian industry so that in addition to producing and assembling the standardized NATO models, it may also produce planes that have been studied with a view to meeting specific Italian needs (training, air defense).

▶ **Experimental Production**—With this in view, priority has been given to the construction for experimental purposes of a small number of the following planes:

• Sagittarius, an interceptor type airplane with sweptback wings and high climbing power. It was designed by Stefanutti, and a first flying model, made of wood, was built by Ambrosini. A limited number is now being made at the Aerfer works in Naples. Italian experts claim this airplane could be the means of defense in the poorer countries of Western Europe. They say its cost is only 15% of that of others of like character, British and American, though these latter have longer range and duration.

• G.82, designed by Gabrielli. Fiat has started building a small series of this plane, used for training fighter pilots. It is fitted with a Rolls-Royce Nene jet engine, and can attain a speed of Mach 0.9.

In addition to these experimental planes, a number of de Haviland Vampires was built in 1953 to be used for training fighter pilots, and the deliveries of the Piaggio 148, the Macchi 416, and the Ambrosini Super 7, ordered in 1951 and 1952, were completed. They will be used for advanced training.

At the aviation experimental station at Guidonia (Rome) three planes built to a basic trainer specification are now being tested. They are the Fiat G 49, the Macchi M.B 323 and the Piaggio 150. The future of these planes will depend on the hoped-for increase in appropriations for Italian aeronautics.

Among the more recent projects (which so far has not got beyond the stage of designs) there is a three-engined jet design for medium-distance transports. Plans for this aircraft have been made independently by Zapata of the Agusta Co., Marchetti of SAI Marchetti, and Casiraghi of Piaggio.

▶ **Spread Thin**—The $42 million so far granted for offshore procurement contracts have enabled Aerfer of Naples to start active work producing under license F-84 fuselage parts. Fiat is doing the same kind of work on the engines and fuselage of the F-86.

But even when we add to these contracts the orders placed by the Italian Ministry for Air Defense, the whole of the work has so far been too widespread and too diversified to permit a revival and general reorganization of production. Present output is still far below the potential of the ten thousand workers now in the employ of the Italian industries engaged in building planes and aeronautic material.

▶ **U.S. Aid Needed**—To assure the steady recovery of aeronautic production, qualified Italian authorities consider that a much greater effort would be required than any so far made; and they hope that further appropriations will be made for this purpose in the near future when the new government revises the defense estimates.

But however willing the government may be to do what is necessary, these same circles are of the opinion that Italian resources will never be sufficient and that further American aid will be more than ever necessary, not only in the form of offshore procurements, but in financial assistance for the purpose of supplementing Italian defense budget estimates.

At the last meeting of NATO, Italy undertook to make a further extraordinary appropriation of 250 billion lire ($400 million) spread over two years for defense expenditure. Within the framework of the NATO programs the Italian authorities also propose:

• To obtain from the U.S. an agreement that the F-86K (50 of which Fiat is assembling) be built entirely in Italy, as an offshore item. A group of factories in North Italy—Fiat, Piaggio and SAI Marchetti—would be engaged, according to the size of the order, in building those planes.

• The same authorities believe that in view of the relations now existing between Fiat and General Electric, it should not be difficult to reach an agreement between the two groups under which the Sabre's engines also would be built in Italy.

Fiat might also make the G.82 trainers, should the trials with the first model give good results.

The concerns controlled by IRI (the

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Italian government) almost all are located in the neighborhood of Naples, would build the Sagittarius. The turbojet engine for Sagittarius has not yet been selected. Alfa Romeo of Naples could build them while the radars could be ordered from Microlambda, and the armament from Sangiorgio and Breda.

These plans might of course be considerably modified should EDC be set up, as the formation of such an organization might make it possible to follow more rational lines in the distribution of the work among the members of the European Defense Community.

▶ **Civil Aviation**—While the conditions of civil aviation in Italy are far from satisfactory, nevertheless the situation seems less unfavorable than is the case with the aircraft factories.

In appraising the situation, a distinction should be drawn between the government's tasks, which have not been carried out because of insufficient appropriations, and those assigned to the companies, to whom the regular line services have been leased. These latter have been carried out to a degree that appears to assure favorable prospects of further development in 1954.

The general direction of civil aviation and air traffic had been charted more than a year ago in a plan approved by the Ministry of Defense which was sent to the Treasury with an application for an assignment of 6 billion lire for the first year and of 12 billion in each of the two following years (rate of exchange 625 lire = $1). The plan was blocked by the treasury until the department that made the request could show the means by which the funds could be procured, as required by Art 81 of the Constitution. This means that nothing will be done until the problem wins favor on the political plane.

Thus the plans which provided for the use of a twin-engine transport to be built in Italy by Piaggio, Agusta or Marchetti were blocked. Lack of funds prevented also realization of a plan for purchase abroad of 27 new four-engine and two-engine planes, and entailed the postponement of the construction of new airfields suited to the needs of present-day civilian traffic at Venice, Palermo, and Genoa.

Work on the new intercontinental airport at Fiumicino was slowed down until the start of 1954, because instead of the 24 billion lire estimated as necessary for the job, only 4 billion was appropriated.

▶ **Closed in the Black**—The only two Italian airline companies now operating—LAI, financed by Italo-American capital, and Alitalia, financed by Anglo-Italian capital—may look back with satisfaction at 1953 and at the prospects for the immediate future. Both companies closed 1953 with a profit, having flown over 50 million kilometers without recourse to any of the subsidies that in prewar days were granted to Italian air carriers.

With the assistance of credit, the airlines have been able to modernize and complete their airfleets with up-to-date American aircraft. At present, the Italian transport fleet includes 10 four-engine planes (DC 6 and DC 6B), already used for the transcontinental services or now expected to arrive, seven twin-engine pressurized highspeed Convair 240s and 340s, and 20 DC-3s, none of which has yet flown more than 8,000 hours.

▶ **More Flights**—The new aircraft now available will allow expansion of the Italian lines and more frequent flights on the more important routes.

It is expected that in the course of the year, flights to New York will be increased from two a week to a daily service, those for South America will have a three-day-a-week service, with stops at various places between Venezuela and Argentina. A line to Tokyo is contemplated, and the services with South Africa and Asia Minor will be extended. New stops will be added in Germany and Scandinavia—**Diego Stramero.**

Spanish Airpower

U. S. Aid Starts Wheels Turning

(McGraw-Hill World News)

Madrid—The mutual aid pact between the U. S. and Spain has taken the lethargy out of Spanish aviation.

Four fields have been chosen as joint U. S.-Spanish air bases: Torrejon near Madrid, Sanjurjo in Saragossa, El Copero in Sevilla, and Moron de la Frontera thirty miles out of Seville. Plans have been drawn to increase the lengths of existing runways on these fields and to strengthen them to accommodate aircraft such as the B-47. Two of the fields, El Copero and Moron de la Frontera, have no runways at present.

Direction-finders, ground-control-approach systems, and other navigational and ground equipment will be installed in anticipation of heavy traffic.

Actual construction awaits the arrival of the personnel from the American combine of Raymond Concrete Pile Co., Brown and Root, Inc. and Walsh Construction Co., who are expected from day to day.

▶ **Training Equipment**—Training equipment and personnel have already arrived. Six jet mobile units have been set up at Talavera la Real in Badajoz to familiarize pilots and train mechanics.

The units contain mockup T-33 engines, bombing-gear and radio equipment. Pilots will receive a short familiarization course here and then go on to North American T-6s and finally into the T-33 jet trainers.

The field at Badajoz has a newly constructed 7,900-ft. runway specifically designed for jet traffic. The first T-33 jets are expected before spring.

The number and types of American jets to be delivered to the Spanish air force is still undetermined. "There is a natural ceiling on the numbers of jet fighters and bombers Spain can maintain," one American spokesman said. "This ceiling is dependent on the ability of the Spanish economy to support them. Spain will receive the amount of aircraft it can support." Spanish Air Force chiefs are studying the problem.

▶ **Three Pilots Per Ship**—The Spanish Air Force intends to throw away everything they have and start over. Currently their fleet is composed of Spanish versions of German Messerschmitt 109 and Heinkel 111. The Construcciones Aeronauticas and Hispano Aviacion factories still have unfilled orders for two hundred more Spanish version

Messerschmitts and Hemkels. After these orders are filled, there will be no more. The total production of military craft has been less than 50 per year, and not all of these have engines. Many of the new engines produced are used to replace old ones in existing craft.

For every ship there are three pilots. The force was increased by 160 pilots last year, bringing the total to approximately 2,000.

▶**Transport Growth**—While Spain's military aviation is still looking ahead, its commercial aviation has been going ahead. Aviacion y Comercio, the private line started in 1949, has been expanding constantly. Last year they put into service two French Languedocs and two Bristol 170s. More planes are on order.

During the past year the government supported airline Iberia, which claims the world's lowest accident rate, added three Bristol 170s and two Languedocs to its fleet of six Douglas DC-4s, 14 DC 3s, two Junker 52s and three de Haviland Dragons. This spring they will receive three Lockheed Super Constellations. The Constellations will be used to expand trans Atlantic operations, possibly extending them to New York.

Iberia now runs to Caracas, Buenos Aires, London, Paris, Frankfurt, Rome, Lisbon (three a day), Geneva, Tangier, Bata, Puerto Rico, Natal and Montevideo. The Bata and Frankfurt runs were added last year. The company has applied for service to Colombia and Miami. Aviacion y Comercio inaugurated three new routes in the past year—Bilbao to Bordeaux, Alicante to Oran and Madrid to Paris.

Last year Iberia operated with 40 crews. At the beginning of this year they had a total of 54 complete crews. The 15 crews at Aviacion y Comercio also represents an increase over last year.

▶**Industry**—The aircraft industry has been very active in development if not in production of commercial planes. Construcciones Aeronauticas (Casa) has designed and produced the Alcotan which can hold about 20 passengers and the Halcon which holds about 30.

These ships are totally Spanish, including original design and research. The prototypes are being tested while factories are retooling for production. The Alcotan and Halcon will be used for domestic airlines. —Jocelyn Bush

Airpower Down Under

Aussie Aviation to Push Modernization

(*McGraw Hill World News*)

Melbourne—There is no doubt that Australians are anxious to preserve their reputation as the world's most air-minded people and ambitious efforts are being made to proceed with modernization of Australian aviation, both civil and military.

It is generally realized that the efforts will be difficult.

RAAF

The Royal Australian Air Force has less than a dozen modern planes to serve its first-class flying and ground personnel. They are still forced to use a large number of long-forgotten aircraft such as Wirraways, Beaufighters and Dakotas, plus obsolescent Lincolns, Mustangs and Vampires. The Australian authorities and experts realize also that when orders for Canberras and Sabres are finally completed, these planes will be also obsolescent.

Planning is therefore aiming at the creation of a rather small but highly maneuverable force equipped with most modern gadgets in the field of rockets and various missiles.

▶**Too Good to Waste**—In many responsible Australian circles it is being argued that in a future conflict, the

Australian Scheduled International Air Services

	Year ended June 30, 1952	Year ended June 30, 1953	% Change 1953 vs. 1952
Route mileage	34,743	57,870	+66.6
Hours flown	35,180	39,393	+12.0
Miles flown	8,014,989	8,964,411	+11.3
Passengers—paying	43,099	48,000	+11.4
Passengers—total	47,498	52,230	+10.0
Passenger miles—paying	196,857,327	208,305,768	+5.8
Passenger miles—total	204,417,285	218,059,085	+6.7
Seat miles available	301,945,151	339,684,855	+12.5
Passenger load factor—% paying	65.2	61.3	−3.9
Passenger load factor—% total	66.8	65.8	−1.6
Average passenger loading—paying	24.5	23.4	−4.5
Average passenger loading—total	25.4	24.2	−4.7
Freight tons	1,195.0	1,249.5	+3.9
Freight ton-miles	5,409,616	5,453,446	+10.3
Mail ton-miles	5,603,951	5,510,293	−2.2
Estimated passenger ton-miles—paying	22,860,679	28,855,221	+5.5
Estimated total ton-miles—paying	33,700,000	35,527,960	+0.6

Source, Civil Aviation Dept.

Australian Air Force will again have to fight in distant lands and that neither the United States nor the United Kingdom will be able to waste the excellent Australian personnel on second rate planes. The implication is that in time of conflict the Western powers will see to it that the Australians are equipped with most modern equipment.

In the meantime, RAAF can hardly buy expensive planes with its meager annual allocation of $110 million which, taking into account the expensiveness of locally built craft, cannot serve the aim of modernizing the fleet. RAAF authorities are still bitter about the failure to obtain modern transport planes from the U.S. as it is thought that this is a very urgent and important need.

▶ **Military Transport Needed**—It is believed that some orders, small perhaps, will be placed finally in the U.S. for a good transport plane for the armed forces to replace the now obsolete Dakotas.

Bristol Freighters, although successfully operated by Australian National Airways, did not prove to be ideal for Australian conditions and were recently grounded for a prolonged period. However experts have failed to agree on a desirable U.S. military transport plane and are further hindered by American inability to supply these planes at a reasonably early date.

The RAAF would also like to have some helicopters, but the chance of getting them seems to be slight.

▶ **Sabre Backbone**—For the time being, Australia's leading fighter plane will be a locally built Sabre jet fighter equipped with an English-made engine and with several valuable locally designed improvements.

Under today's conditions this is a good plane, but Commonwealth Aircraft Corp., which is building it, had to overcome a lot of obstacles and delays and mass production is only now about ready to begin. It is understood that the Sabres will cost about £A250,000 each ($562,500) and latest changes introduced comprise a new integral starter motor, new-type leading edges on the wings and improvements of the ammu-

Australian Scheduled Domestic Air Services

	Year ended June 30, 1952	Year ended June 30, 1953	% Change 1953 vs. 1952
Route mileage	86,800	83,580	−3.7
Hours flown	270,615	248,788	−8.1
Miles flown	43,355,974	40,707,871	−3.9
Passengers—paying	1,837,965	1,747,789	−3.9
Passengers—total	1,879,331	1,769,165	−3.9
Passenger miles—paying	745,861,911	697,909,000	−6.4
Passenger miles—total	766,507,124	707,216,897	−5.3
Seat miles available	1,136,849,791	1,084,345,253	−4.7
Passenger load factor—% paying	65.4	65.2	−1.2
Passenger load factor—% total	68.5	65.2	−1.1
Average passenger loading—paying	17.2	18.9	+5.1
Average passenger loading—total	17.5	18.8	+7.4
Freight tons	65,304.5	65,712.8	+0.7
Freight ton-miles	27,337,308	27,876,305	+2.0
Mail ton-miles	1,383,351	1,301,465	−5.9
Estimated passenger ton-miles—paying	74,553,161	69,799,061	−6.4
Estimated total ton-miles—paying	105,288,818	98,598,271	−6.2

Source, Civil Aviation Dept.

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mition feed The guns of the Australian Sabre are also larger than those of U S built Sabres (AVIATION WEEK Feb 8, p 32).

So far the initial order for 72 Sabres has not been increased and a decision on an eventual increase is unlikely in the near future It all depends on the world situation at the end of 1954 and of the progress made by CAC with the manufacture of the fighters

North American Aviation helped CAC with the project to a very considerable extent

▶**Canberra Cost**—The high cost of making the Canberra in government-owned factories in Australia is worrying the defense authorities and treasury officials alike. Latest estimates quote over £400,000 ($900,000) as the current cost of locally produced Canberra jet bombers, but independent, reliable observers quote the cost as being closer to £450,000 or more

The operations of the government-owned aircraft factories are subject to strictest secrecy and it is not known whether the high cost was due to a lagging efficiency or to cost of tooling-up and high Australian wages

The fact remains that Australian-built Canberras were 60 to 80% more expensive than the same product in an English factory This led, of course, to serious consideration of the problem as to whether local aviation manufacturing industry should be encouraged

▶**Need for Home Industry**—RAAF complained of the high cost of Canberras, but realized that a local manufacturing industry is desirable for emergencies and as a source of spare parts and general maintenance On the other hand, the industry was not too efficient and has had always to start work on a plane developed abroad at a time when the modern aspects of that particular plane were already subject to doubts based on current research and achievements

It is a question, the solution of which the Government will have to find in the near future

Up to the time of writing, RAAF was flying about six Canberras (including the imported ones) The experience was good, but the cost was nevertheless worrying RAAF leaders (for the first time led by an Australian-educated Air Marshal)

Australia seems to be self-sufficient in trainers, with both CAC and de Havilland producing an acceptable pair. Here again it is not expected that orders will be increased

▶**Pilotless Aircraft**—Modernization will be most pronounced in the field of pilotless planes Orders for the improved Jindivik are understood to amount to 54 units

The new Jindivik Mk 2 will have at least 50% greater power output than the Jindivik Mk 1, of which only 12 were ordered

There are many plans for the utilization of this small plane, but some experts believe that it will be an excellent expendable bomber with an atomic warhead

Jindivik will certainly be used fully in conjunction with the newly developed British rockets The plane is expected to be a relatively cheap proposition, and many federal government officials believe that in the future the Government Aircraft Factories should entirely concentrate on producing this sort of equipment, perhaps even for export to United Kingdom on the understanding that the U. K will supply Australia with larger modern aircraft

▶**Rocket Interception**—Out of the pilotless plane developments came a secret and radical plane on which initial experiments are being carried out It is a delta wing craft plane for interception of enemy-launched rockets. It is expected to climb at 50,000 feet a minute and reach a top speed of Mach 3 First models will probably carry a pilot (stretched on a foam rubber mattress so that pressures will be equally distributed over all his body) It may fly at heights up to 12 miles and will be

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launched from mobile interceptors.

When experiments are completed, the plane may be built in Australia, although its engines probably will be imported from the U. K. It is being tested at Woomera.

Naval Aviation

Naval aviation is developing slowly.

Fireflies and Sea Furies are the Navy's most modern aircraft but plans are advanced for the use of Fairey Gannets (fitted with Twin Mamba turboprop engines) for close-range anti-submarine work and for Sea Venoms for ordinary naval fighter purposes. The question is still not decided, but it is possible that de Havilland will build Sea Venoms in its Bankstown, Sydney, plant. Australian aircraft carriers will be fitted with angled flight decks and with steam catapults.

One aspect preventing the Fleet Air Arm from attaining its plans is the shortage of volunteers for training as pilots. Extensive plans are under way to attract more of the right sort of people to the force.

Export & Import

Australian aviation manufacturing circles are still pressing for more initiative in capturing neighboring markets for Australian planes. They argue that a price reduction of up to 30% will be possible if larger orders are placed.

But considerations against such proposal are numerous. From the political point of view, Australian authorities are entirely unenthusiastic about seeing an Indonesian or other Air Force so close to Australia.

On the other hand, the British aviation industry is unwilling to lose markets and English influence prevents New Zealand from even entertaining the idea of buying in Australia while it is doubted if the present capacity of Australian production is adequate to cater to exports as well as home needs.

▶ **Second-Hand Heaven**—In the meantime, Australia is a happy hunting ground for American and other buyers of second-hand aircraft. Civilian airline operators are slowly disposing of their obsolete planes, which are bought for conversion to executive planes in the States, or as meteorological planes (as was the case with a recent load of Mosquitos).

Even greater problems are being faced in the field of imports. ANA's purchase of DC-6s instead of Vickers Viscounts provoke bitter English criticism. So did Qantas' decision to buy Super-Constellations. If Labor is returned to power in the middle-year

general elections of 1954, it is certain that its policy will be to buy British rather than American planes

Civil Transport

Principal Aussie airline operators are preparing for a major reorganization in connection with their modernization of fleets

Australian National Airways, which is still a leader, and particularly in the air cargo field, has purchased two second-hand DC-6s and has two DC-6Bs on order. The planes proved to be very popular on Australian domestic routes, and ANA's principal competitor, Trans-Australia Airlines was also compelled to charter a KLM DC-6 to meet the opposition.

TAA is expecting its fleet of six Viscounts soon for use on domestic Australian flights. It is not yet known what ANA's next step will be in the modernization campaign, as the private owned airline is still fearful that a trend toward Labor may mean nationalization of ANA

▶ **Douglas Fan**—ANA was always a consistent buyer of Douglas planes, and its technical staff likes the big U. S. planes, although considerable efforts are being made to persuade it to turn to Bristol Britannias. TAA, if satisfied with Viscounts, may buy more of them or a later model of a similar plane

Both airlines will probably have a problem with replacements for their DC-3s on feeder services.

Other Australian airline operators are also interested in a good cheap safe and efficient replacement for DC-3s and for smaller planes. The only airline which tried de Havilland Herons is Butler Airline no other airline seems ready to follow the example

Last year saw the "rationalization agreement" between ANA and TAA and services were readjusted, with airmail going also to ANA. Recent demands by airline pilots for higher wages and salaries may yet mean an increase in fares and rates and this may affect the traffic

▶ **Business Pickup**—Following a slack business period in Australia, major airlines have started to participate in a business recovery. Christmas 1953 saw records being beaten by both ANA and TAA. In Australia's traditionally busy pre-Christmas week, the two principal airlines carried over 40,000 passengers and ANA carried in a fortnight over 4 million lb. of air cargo.

TAA's freight was 20% better than its previous best. In one week, Essendon's busy control tower handled 1,386 aircraft movements.

▶ **International Merger**—In the international airline field, the most important events were the prolonged negotiations for a merger of British airlines in the Pacific area. Several plans were formulated, accepted and rejected, and agreements were reported at least four times. The final agreement remains still to be ratified.

Latest reports from usually very well-informed circles claimed that lack of agreement on some points of importance may yet stop the merger.

Qantas has continued development of its services, but BCPA has been looking somewhat anxiously at the steadily developing competition on its routes to North America. Prospects of operating Comets by BCPA were viewed with limited enthusiasm by the airline's chief executives. Furthermore, the return of good and relatively cheap British ocean liners to the Australia-North America route was casting a definite shadow on future air operations on this route.

High hopes are, however, placed on the forthcoming start of "coach fare" flights on this route

Research

Research activities were limited this year to some work at the Aeronautical

Research Laboratories and to expanding activities at the Woomera station in South Australia.

At the Woomera range the British and the Australians were engaged in testing a new bomb for special use from highspeed high-altitude jet bombers. Strangely enough, a modified nonjet Lincoln bomber was used for these tests. The bomber's inner units were standard Rolls Royce Merlins, but its outer engines were Armstrong Siddeley Python turboprops so it is able to climb to altitudes about 40,000 feet in relatively fast time. A Canberra jet bomber has also been used.

Other interesting research at Woomera is the current investigation of high altitude clear-air turbulence, which is of great importance to jet operations.

The valiant part played by the Australian Air Force in Korea has won the admiration of everyone plus a considerable amount of decorations.

A transport unit is also operating in Japan, two fighter squadrons are gaining valuable overseas experience in Malta and a bomber unit, equipped with Lincolns, is hitting rebels in Malaya. It is a good show for the relatively small population of Australia and a mark of their outstanding interest in aviation.—Marcel Grobtuch

The Netherlands

Dutch Air Strength Ahead of Schedule

(McGraw Hill World News)

Amsterdam—The forecast for Dutch airpower this last year could read "Bright and continued sunny."

Military aviation was on or ahead of schedule. Production was expanding. Commercial aviation beat the previous year's totals.

Air Force

The expansion and modernization of the Royal Netherlands Air Force continued in 1953. In fact, expansion is ahead of planning. It is hoped that the final buildup of 21 fighter squadrons will be completed in 1954.

▶ **Fighter Strength**—The delivery of 150 Gloster Meteor 8 fighters by Fokker Royal Dutch Aircraft Factories is nearly complete and will be fully completed early this year.

The Gloster Meteors of Air Defense Command will, however, gradually be transferred to technical operations, and replaced as fighters by 156 Hawker Hunter F. 1 jets, construction of which now has been started by Fokker with Aviolanda and de Schelde.

Tactical Command has increased its Thunderjet squadrons.

▶ **Bases and Training**—Plans for 1954 include a large scale expansion and modernization of a number of airfields. New fields will be put into operation, especially at Ypenburg near The Hague.

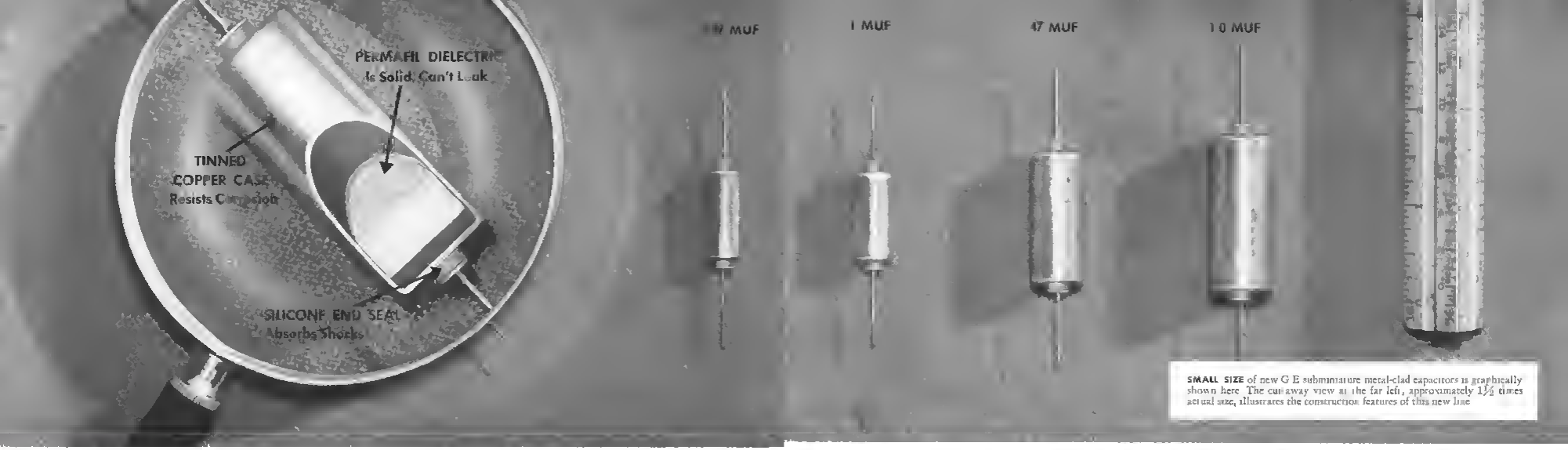
Further progress will be made with regard to bringing the operational squadrons up to war force. New methods of pilot training, based on American method, have been introduced. The training time has been shortened, but the number of jet hours has been increased.

Although the Air Force has as yet no night fighters at its disposal, personnel is being trained for this special task.

Naval Air Service

The Naval Air Service has been strengthened in 1953. It consists of:

- Light fleet aircraft carrier Karel Doorman, with one fighter squadron (Hawker Sea Furies), one anti submarine squadron (Fairey Fireflies and Grumman Avengers). There are two reserve squadrons.
- Three anti-submarine squadrons (Fireflies, Grumman Avengers, Lockheed Harpoons and Neptunes).
- Two fighter squadrons (Sea Furies).
- One squadron for miscellaneous services (Austers, Firefly trainers).
- One aircraft rescue squadron (Mitchell



SMALL SIZE of new G E subminiature metal-clad capacitors is graphically shown here. The cutaway view at the far left, approximately 1½ times actual size, illustrates the construction features of this new line.

G-E SUBMINIATURE METAL-CLAD CAPACITORS

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Case sizes range from .235 inches in diameter and 11/16 inches in length to 1 inch in diameter and 2⅝ inches in length.

Liquid-filled metal-clad line also available with G E Pyranol* dielectric for operation from −55C to + 85C without derating. Lower cost, they incorporate all the operating advantages of the solid dielectric line and are supplied in the same ratings.

For more information see your G-E Apparatus Sales Office, or write for bulletin GEC 987 to General Electric Co., Sect. 442-18, Schenectady 5, N. Y.

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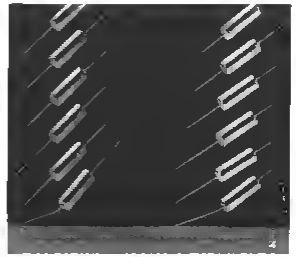
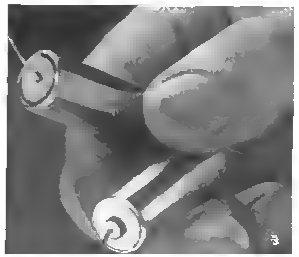


2. Withstands vibration and rough handling. This view shows a glass-bead-sealed capacitor and a silicone-sealed capacitor being dropped.

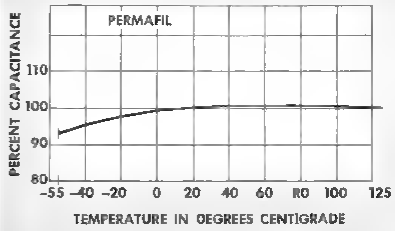


3. Undamaged by dropping, the two capacitors are shown here—note that there are no cracks in the G-E silicone-sealed unit.

4. At +125 degrees centigrade, the capacitor consistently maintains 100 percent capacitance.

5. At −55 degrees centigrade, the subminiature G-E metal-clad capacitor with Permafil dielectric shows less than 7 percent loss in capacitance.

6. Capacitance vs. temperature is shown by this typical curve. G-E capacitors with Permafil dielectric have very little capacitance change throughout the entire range from −55 C to +125 C.



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patrol planes, Lockheed Harpoons and a number of Sikorsky helicopters).

A number of Lockheed Neptunes (anti submarine patrol planes) have just been received from the U. S., as well as a number of Grumman Avengers. A further supply is expected in 1954.

Production

Fokker of Schiphol, near Amsterdam, finished the main part of its Gloster Meteor Mk. 8 order in 1953. The en-192 for Belgium and 156 for the Royal Netherlands Air Force) will be completed early this year.

As the successor of the Meteor, 460 sweptwing Hawker Hunter F. 1 jet fighters will be produced. Of these, 112 are destined for the NATO countries under U. S. offshore procurement, 192 for Belgium and 156 for the Netherlands. Parts of these aircraft will be constructed by Aviolanda (of Papendrecht) de Schelde (of Dordrecht). The engines are to be constructed by Belgium.

▶**Fokker Designs**—The S.14 Mach Trainer Mk. 1 has been tested by many foreign teams. A series of this type is currently under construction for the Royal Netherlands Air Force, and another batch will be built for the Brazilian Government. The S.14 Mk. 2 is now powered with the Rolls-Royce Nene engine, this type is currently being tested by Dutch and foreign missions.

Fokker established a Brazilian-Dutch Fokker company, Fokker Industria Aeronautica S. A., in Rio de Janeiro in 1953. This company will build under license an initial order of 100 S. 11 Instructors, 50 S. 12 instructors, (nose wheel version), and 50 S. 14 Mach Trainer Mk. 1 side-by-side jet trainers for the Brazilian government.

Production started in 1953 of 6 Saab Scandia civil airliners, the first of which will be delivered sometime this year.

Development work started in 1953 on the new Fokker F. 27 Friendship twin-turboprop 28-36 passenger airliner, of which two prototypes are under construction.

Fokker's main 1954 production will be the Hawker Hunter series for NATO forces.

Fokker S.14 Mach Trainer production will be continued and will probably be enlarged by new orders. F 27 construction will be in full swing.

▶**The Lineup**—This will be the Dutch production lineup in 1954:

Fokker's factories will have a capacity of 830,000 sq. ft. and employ 2,200 by May.

• **Aviolanda** has 300,000 sq. ft. and a 1,000-man work force.
• **De Schelde** has 55,000 sq. ft. and 300 personnel.
• **Avio-Diepen** of Ypenburg (repair work) has 86,000 sq. ft. and some 300 personnel.

Civil Aviation

KLM Royal Dutch Airlines suffered a severe loss by the death of its founder and president (on the last day of 1953), Dr. Albert Plesman. No successor is contemplated at present.

Aside from this blow, the year has been a satisfactory one for Dutch aviation.

▶**Traffic Results**—KLM's traffic totals for 1953 show a general improvement over 1952's figures. The following listing compares the two years, with the 1953 results given first, followed by the 1952 figures, and the percentage improvement.

• Distance flown (km.), 48,800,000, 44,700,000, 9%.
• Hours flown, 147,000, 134,000, 10%.
• Available ton-km., 247,700,000, 240,800,000, 14%.
• Passengers, 600,000, 517,000, 16%.
(passenger-hrs. in 1953 totaled 1,330,000,000).
• Freight (kilos), 14,990,000; 14,350,000, 4.5%.

Super Constellations in service and four more are to be delivered in 1954. Twin Douglas DC-6A Liftmasters and 10 Convair 340s are still on order. Of the 14 Convair 340s which KLM will soon possess, six are to be allocated to the West Indies Division.

When all the airliners now on order are delivered (and after the sale of five Constellations and three Convair 240s), KLM in 1954 will have a fleet of 91 aircraft, the majority being of the most up-to-date type.

The KLM network has a total route mileage of 131,850 miles. Several enlargements incurred in 1953. It now serves 102 cities in 67 countries (34 cities in the Western Hemisphere).

▶ **Miscellaneous Data**—The number of charter flights was about 48% more than in 1952 (325 against 220). In addition 86 emigration flights took place.

In 1953 KLM won first prize in the handicap section of the London-New Zealand air race.

During the weeks following the flood disaster in Holland at the beginning of February 1953, KLM brought in 350 tons of relief supplies from over 30 different countries.

The number of personnel is now 13,545. Flying personnel totals 1,340, including 520 pilots—Paul Catz.

Sweden

Defense Strength Is Spread Thin

(McGraw-Hill World News)

Stockholm—In last year's defense budget, the Swedish Army got about all it asked. This year sees a swing back in favor of the Air Force. Of a total defense outlay of just over 2 billion kronor (about $388 million at the rate of one krona = 19.3 cents), the Air Force now gets 34%, compared with only 30% last year. This means the AF gets altogether 689 million kronor.

With the Army now getting 40% and the Navy 20%, the division of funds between the forces is back at the 1952 5-3-3 ratio.

▶ **Seven-Year Program**—In the new budget the allocation for the Air Force seven-year procurement program is raised from 2,105 to 3,150 million kronor (about $600 million). This will enable it to meet the increased costs of new equipment, and makes replacements at a reasonable rate.

The yearly appropriation for equipment purchases is increased by 100 million kronor to 450 millions. Funds will be applied mainly to buying jet fighters from England to replace obsolescent planes, and procuring a new fleet of transports. The number of fighters will not suffice for replacing the Spitfires now used for reconnaissance with more modern aircraft, and over the long period there will be less rather than more fighters in service than there are now.

It may be noted that the most prominent item in Sweden's budget is not defense but social welfare expenditures. This situation will now be accentuated, too, by the introduction of a costly system of compulsory sickness insurance.

Taxes are already too high for the maintenance of a really healthy economy—especially as they are relatively heavy (quite low down) on the income scale. Consequently 2 billion kronor for defense has come to be something of a magic figure in Swedish budgetary thinking. Seeing that an defense is not only growing in cost but also in relative importance, pressure to reduce the Army and Navy share of the defense total is obviously going to increase in the coming years.

▶ **Strictly Defense**—At present, Sweden's air defense consists mainly of day fighters. There is no retaliatory bomber force whatsoever, and not being a member of NATO, Sweden will not have tactical atomic weapons.

Gen. Bengt Nordenskiold, com-

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mander in chief of the Swedish Air Force, has stated frankly that NATO will have to supply bombers if Sweden is to be defended. In fairness, it should be added that Gen. Nordenskiold has also put it on record that personally he thinks Sweden ought to contribute to Western defense by joining NATO.

But even assuming NATO bomber support, Sweden's 10 day fighter and four tactical plane wings would have a task probably beyond their means—especially if the Russians advanced their fighter bases into Finland and on to the Baltic islands of Gotland and Bornholm.

▶**Spread Thin**—Sweden extends about 1,000 miles from north to south, and there are important military areas, communications centers, industrial plants, cities, storage depots, and power stations scattered all over the place.

Something of the dilemma involved was indicated by Gen. Nordenskiold in an address in Gothenburg nearly two years ago. There he said flatly that instead of one day fighter wing which it has now, for adequate defense Gothenburg needs two day wings and one night fighter wing.

No such increase is on the cards, however, although Gothenburg is Sweden's most important port and the only one of any capacity for receiving supplies from the West. Urgings from various quarters to open up an alternative supply route via the Norwegian port of Trondheim have met no response from the neutralist government.

▶**No Atom Missiles**—In the circumstances, Swedish defense thinkers are turning their attention more and more to the possibilities offered by guided missiles and atomic weapons. Swedish scientists could doubtless produce atom bombs, but the willingness of the West to assist with these new weapons also hangs a good deal on Sweden's foreign policy line. And without Western aid, at least in know how, a small country's chances of acquiring them at reasonable costs are slim. Sweden's experience with jet engines shows that.

Sweden needs more anti-aircraft equipment, both of the conventional and guided-missile type. The radar warning system also needs extending. A lot of this is not even in the planning stage, but in any case it will cost a lot of money and will probably entail a considerable rearrangement of the overall defense setup.

The idea of atomic bombs, or at least the cost of them, does not seem popular in the Socialist circles that govern the country. Obviously, however, they would improve the chances of defense against invasion and could provide Sweden with a retaliatory weapon, especially in guided missiles.

▶**J-29 and A-32**—In the meantime, Sweden's Air Force is going to have to get along with conventional equipment—and less of it, rather than more. Equipping day fighter wings with J-29s is still in process, and manufacture of engines for the Lansen A-32—with which the four tactical support wings are to be equipped—will not start until mid-1955.

At the most about 200 of the all-weather A-32 appear to have been ordered. Saab is delivering some 600 J-29s, all told, but not all of those delivered are going to the interceptor groups. A number are being used for ground support, and some for reconnaissance.

The J-29 is now approaching obsolescence, anyway, and no new Swedish fighter is in sight. Saab is developing a new type from the handy little delta-wing Draken, but no decision has yet been made as to what engine to power it with. To bridge the gap, the Swedes are looking to purchases of Hawker Hunters and Supermarine Swifts from England.

▶**Production Expansion**—To build Lansens, while still turning out J 29s, Saab is adding 10,000 square meters of factory space at its Linkoping plant. Together with some 2,900 sq. mi. of additional hangar space, the cost of this expansion will run to 40 million kronor ($7.6 million).

One reason for the expansion is that the Lansen is a bigger plane than the J 29, and requires more space for production. But Saab also has an eye to possible orders from abroad.

Production facilities are also being expanded at the Flygmotor plant at Trollhattan where Rolls-Royce Avon 7 jet engines will be built for the Lansen. Here, too, expansion does not necessarily mean that more units will be produced—only that the Avons require many more man-hours. Previously Flygmotor has manufactured de Havilland Goblin engines for mounting in British built Vampire airframes, and is now engaged on the production of Ghosts for the J-29.

Saab's production of J-29s reached the scheduled rate in 1953. Company sales had then increased fourfold, compared with 1946-48, and turnover rose from 44 million kronor in 1948 to 152 million in 1953. Last year, too, the balance sheet showed an increase from 11 to 79 million kronor in the book value of raw materials, semi-manufactures and work in progress. Compared with 1952, profits had risen from 1.9 to 7.2 million kronor.

Sweden's rather lonely aircraft industry is turning out to be good business.

—G. Howard Smith

U.S. Aircraft Industry—1953

Company	Location	Plant Area (Sq. Ft.)	Plant Employment	1953 Sales ($)	Backlog '53
Aercar, Inc.	Longview, Wash.	3 000	10	None	*5 000
Aero Design & Engineering Co.	Bethany, Okla.	51 000	500	3 804 000	490 000
Andrason, Greenwood & Co.	Bellaire, Tex.	20 000	70	398 000	381 000
Baumann Aircraft Corp.	Pasadena, Calif.	10 000*	25*	112 000	684 000
Beech Aircraft Corp.	Wichita, Kans.	2 000 000	5 500	146 457 784	
Bell Aircraft Corp.	Buffalo, N. Y.	5 000 000	30 556	179 700 000	706 893 873
Boeing Airplane Co.	Seattle, Wash.	11 711 370	20 358		
Central Lamson Corp.	Yakima, Wash.	2 445	18		
Cessna Aircraft Co.	Wichita, Kans.	1 015 000	4 35*	43 500 931	90 300 000
Consolidated Vultee Aircraft Corp.	San Diego, Calif.	11 710 000*	44 733	285 000 000*†	1 000 000 000+
Curtiss-Wright Corp.	Wood-Ridge, N. J.	5 170 000	30 000	317 868 401†	1 000 000 000*
Daman Helicopters, Inc.	Danbury, Conn.	77 000	41		400 000
Douglas Aircraft Co., Inc.	Santa Monica, Calif.	12 911 400	96 500	574 485 000	2 206 000 000
Frederic Flader, Inc.	No. Tonawanda, N. Y.	55 943	214	3 098 719	954 000
Fletcher Aviation Corp.	Pasadena, Calif.	128 050*	300	18 580 010	14 346 256
Goodyear Aircraft Corp.	Akron, Ohio	4 013 250	13 000		
Grumman Aircraft Engineering Corp.	Bethpage, L. I., N. Y.	2 988 505	11 200		844 100 000*
Gyrodyne Co. of America, Inc.	St. James, N. Y.	39 000	95	486 000	1 850 000
Jacobs Aircraft Engine Co.	Pottstown, Pa.	175 000	585	6 780 000	3 000 000
Kaman Aircraft Corp.	Bloomfield, Conn.	174 172	1 300	11 000 000*	30 000 000
Lockheed Aircraft Corp.	Burbank, Calif.	11 000 000	51 548	800 000 000+	1 400 000 000+
Lycoming Div., Avco Mfg. Corp.	Stratford, Conn.	2 800 000	10 000		
Glenn L. Martin Co.	Baltimore, Md.	4 800 000	20 000		
McDonnell Aircraft Corp.	St. Louis, Mo.	2 500 000	12 000		
Meyers Aircraft Co.	Tecumseh, Mich.	45 000	45	427 000	500 000*
Northrop Aircraft, Inc.	Hawthorne, Calif.	3 000 000+	22 500	184 230 000	499 000 000*
North American Aviation, Inc.	Los Angeles, Calif.	8 582 000	53 002	624 985 156	1 170 000 000
Piasecki Helicopter Corp.	Morton, Pa.	813 000	4 580	58 000 000*	135 000 000*
Republic Aviation Corp.	Farmingdale, N. Y.	2 200 000	26 000		
Ryan Aeronautical Co.	San Diego, Calif.	750 000	4 100	50 000 000	50 000 000
Taylorcraft, Inc.	Conway, Pa.	81 000	95	000 000	150 000
Temco Aircraft Corp.	Dallas, Tex.	1 847 712	5 700		
United Aircraft Corp.	E. Hartford, Conn.	10 400 000*	62 000*	579 605 307†	1 350 000 000*†
Chance Vought Aircraft, Inc.	Dallas, Tex.	2 224 750	13 000		340 000 000
Westinghouse Electric Corp.	Pittsburgh, Pa.	132 700	1 000 000 000*		

*—Approximate
† Fiscal year ending Sept. 30, 1953.
‡ For 9 months ended Aug. 31 1953.
§ Period ending Sept. 30, 1953.
‖ Now 116,000-sq. ft. factory completed Mar. 1, 1954
¶ For fiscal year ended July 31, 1953.
# As of Oct. 31, 1953.
** For 9 months ended Sept. 30, 1953

Source: Industry reports to AVIATION WEEK

SHIPMENTS BY PLANTS OF COMPLETE CIVILIAN AIRCRAFT AND ENGINES

	Cumulative Totals—January-December		
	1951	1952	1953
Complete aircraft, total airframe weight (thousands of pounds)	2 110 0	9 832 3	10 268 7
By weight of plane			
Under 3,000 lb. airframe weight	1 067 9	3 456 3	3 471 9
3,000 lb. airframe weight and over	3 906 1	6 000 0	7 267 2
By number of places			
1 and 2-place	340 0	2 098 0	3 464 0
3- and 5-place	1 581 1		
Over 5-place	6 213 1	8 000 5	7 304 7
By total rated horsepower all engines			
Under 100 hp	75 0	2 098 0	3 464 0
100-399 hp	1 914 1		
400 hp and over	3 819 0	8 000 5	7 304 7
Complete aircraft, total number	2,477	8 909	4 134
By weight of plane			
Under 3 000 lb. airframe weight	2 379	3 037	3 825
3 000 lb. airframe weight and over	198	482	309
By number of places			
1 and 2-place	814	3 086	3 822
3- and 5-place	1 561		
Over 5-place	202	483	312
By total rated horsepower all engines			
Under 100 hp	150	3 056	3 822
100-399 hp	2 123		
400 hp. and over	204	483	312
Aircraft engines, number	4 580	5 382	8 647
Aircraft engines, total horsepower (thousands of horsepower)	2 053 9	2 930 7	4 306 3
Value of shipments of plants producing complete aircraft, total (thousands of dollars)	$132 187		
Complete aircraft and parts, total	138 917	278 970	340,990
Aircraft, total	95 844	107 181	244 415
Under 3 000 lb. airframe weight	14 261	29 532	35 389
3 000 lb. airframe weight and over	74 643	173 299	211,503
Aircraft parts	40 173	53 010	90 663
All other products (including conversions)	44,170		
Value of shipments of plants producing aircraft engines, total (thousands of dollars)	$69 562		
Aircraft engines and parts, total	87 632	147 000	154 413
Aircraft engines	66,009	40 722	70 854
Engine parts	21,723	106,278	83,561
All other products	7 930		

NEWS DIGEST

Domestic

World's speed record is held officially by North American Aviation's F-100 Super Sabre with a mark of 755.149 mph., Federation Aeronautique Internationale has ruled. The F-100 set the record Oct. 29 in two runs over a 15 km. course at Salton Sea, Calif., during a speed battle with Douglas Aircraft's F4D Skyray, holder of the 3 km. 753.4-mph. mark. (AVIATION WEEK Nov. 9, p. 14).

Rapid Senate confirmation of Navy Secretary Robert B. Anderson's nomination as Deputy Secretary of Defense was expected last week. He will succeed Roger M. Kyes, who has resigned effective May 1.

RF-84F Thunderflash, photo-reconnaissance version of Republic Aviation Corp.'s F-84F jet fighter, is entering volume production at the aircraft builder's Farmingdale, N. Y., plant. The jet has air-intake ducts at the wing roots to permit nose camera installations, mounts four .50-caliber machine guns. USAF has taken first deliveries on the RF-84F.

American Airlines will begin installing Bendix Aviation's ignition analyzer No. 11 33651 in its 25 DC-7s during April or May.

Beech Aircraft Corp. has received a supplemental USAF contract for 50 additional T-34A trainers, extending present production rate to August 1955. Beech also is building T-34s for Japan and Chile.

North American Airlines' secretary-treasurer, Stanley Weiss, left last week for Vienna to continue negotiations with the Austrian government on formation of Austria's proposed national airline. (AVIATION WEEK Mar. 8, p. 52). The nonsked is interested in supplying equipment and crews.

Assembly lines at Sperry Gyroscope Co.'s paralyzed Lake Success, N. Y., plant began turning out full production last week, freed by striking engineers who opened their picket lines to 14,000 union electrical workers. The Engineers Assn. called the walkout two weeks ago in a demand for a 15% wage increase. (AVIATION WEEK Mar. 8, p. 7).

Francis H. McAdam has resigned as CAB trial attorney to join Mayer, Meier, Austrian and Plant, Chicago law firm that handles United Air Lines' account.

New York Airways has cut its helicopter passenger fare between New York's La Guardia and Newark Airport terminals from $15 to $10.

Camille (Rosie) Stein, 51, longtime official and a director of Northwest Orient Airlines and one of the first women to hold a job in U. S. civil aviation, died Mar. 8 in St. Paul.

F. G. Dawson, executive assistant to Sikorsky Aircraft's general sales manager, died Mar. 8 at Westport, Conn. He was 61.

Financial

Curtiss-Wright Corp., Wood Ridge, N. J., reports net income of $11,402,791 for 1953 from sales totaling $438,728,482, compared with the preceding year's $9,047,514 net and $326,183,643 in sales. Present backlog more than $865 million.

Ryan Aeronautical Co., San Diego, had a net profit of $595,033 during the first quarter of fiscal 1954, approximately the same as the first period last year. Sales and other income totaled $11,564,917. Ryan's forecast for the year "continued high level of business."

Hiller Helicopters' net income last year totaled $247,637, a drop of $369,422 from 1952. Sales and other income for the Palo Alto, Calif., copter builder added up to $10,414,641 compared with $14,414,024.

Boeing Airplane Co.'s directors have proposed a two-for-one split of capital stock, subject to approval of shareholders at an annual meeting Apr. 27.

International

Dassault Mystere 4B has exceeded the speed of sound in level flight at 25,000 ft., reports test pilot Constantine Rozanoff. The French jet fighter is the first produced for NATO in Western Europe to crack Mach 1 without the aid of a dive.

Canadair has received a $24 million order from the Canadian government for 100 additional F-86 Sabre fighters powered by Avro Orenda jet engines and possibly armed with rockets and air-to-air guided missiles now being developed in Canada. The Montreal company already has built 900 Sabres under license from North American Aviation.

First View of Douglas Skyworriors in Formation

Production model Douglas A3D twin-jet Navy bomber leads two experimental XA3D-1s in a formation flight over California's Mojave desert. The carrier-based A3D recently was named the Skywarrior. Production Skywarriors are fitted with P&WA J57 turbojets in the 10,000-lb.-thrust class slung in pods under the swept wings. Each of the three planes shown in the above photo differs slightly, particularly in engine cowling configuration. Note tail guns mounted on center Skywarrior. Douglas notes that the A3D has been designed to operate from Navy carriers presently in operation as well as from the new, larger Forrestal class now under construction.

Colonial Asks New Merger Bids

Eastern employes dump 100,000 shares of smaller firm; NAL, Mohawk try to block Rickenbacker move.

Presidential veto of the Eastern-Colonial Airlines merger (AVIATION WEEK Mar 8, p 51) caused strong reaction throughout the industry last week

Here are the developments

- **Colonial** invited EAL and National Airlines to submit new bids
- **Eastern** ordered its employes and directors to sell all Colonial stock, prompting Laurence S Rockefeller, holder of the largest single block of stock (26 200 shares), and others to sell immediately the 100,000 Colonial shares concerned
- **National** petitioned Civil Aeronautics Board to proceed with hearings on a Colonial-National merger and asked CAB to restrain Eastern from bidding for Colonial until such hearings are completed
- **Mohawk Airlines** asked CAB to restrain EAL from bidding for Colonial until the National hearings are completed
- **Interest** in Colonial stock was aroused outside the airline industry
- **The Board** ordered Eastern to show cause within 10 days why it should not be directed to terminate control of Colonial and why it should not be directed to cease and desist from acquiring control of the smaller airline or any of its routes or assets "without prior approval of the Board."

Capt Eddie Rickenbacker, EAL board chairman, was known to be highly miffed at the President's decision and was reported even more determined to merge with Colonial at any cost

► **Action Considered**—Meantime, Justice Department was reported to be considering action against Eastern for its premature control of Colonial, the factor that caused the President to veto the merger agreement

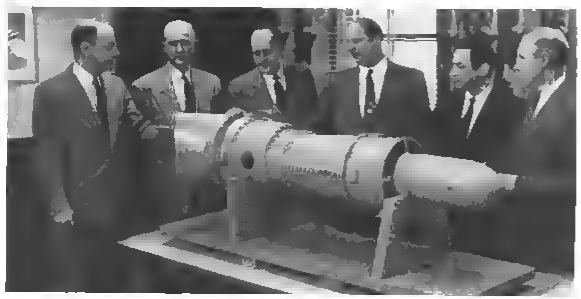
Because EAL's controlling ownership of Colonial stock was "unlawful" under the terms of the Civil Aeronautics Act, the Justice Department could—after CAB filed an injunction against the airline—initiate action against Eastern

Following Eastern's decision to divest itself of all Colonial shares Mar 5, the Stock Exchange reported hurried selling of Colonial stock The stock immediately was affected, rising from 11⅞ to 12¾ at the close of the day last Tuesday Its high has been 14 this year

► **New Bids**—Colonial's board of directors was scheduled to meet in New York last week to open sealed bids solicited from Eastern and National CAB was expected to act on the National and Mohawk petitions before the week end

No indication was forthcoming from the Board as to how it might move in the matter, but in its order reporting the President's veto, CAB noted it would continue the National-Colonial merger hearings

Mohawk favors continued hearing of the Colonial merger case because it wants the short haul, local service routes of the present Colonial system Thus it filed a petition at the same time National did last week, asking the Board to restrain Eastern from bidding for Colonial until the hearings are concluded



GE Previews Baby Jet

First photo of General Electric's new XT58 gas turbine, designed for Navy BuAer primarily as a helicopter powerplant, shows a mockup of the engine being viewed by members of GE's recently formed Small Aircraft Engine Dept Only company comment on the XT58's power is that it is "six to eight times as powerful" as a family car engine. Grouped by the turbine, left to right: L I Asher, manager of finance, L T Callahan, manager of manufacturing, J F Tunnel, Jr., manager of marketing J S Parker, general manager, E Woll, manager of engineering, and H T Hokanson, XT58 project manager, who will direct design, development and applications.

House Passes CAA, CAB Budgets for '55

The House has approved fiscal 1955 budgets for Civil Aeronautics Administration and Civil Aeronautics Board without significant change in the Eisenhower Administration recommendations (AVIATION WEEK Jan 25, p 14)

The House took these actions

- Passed a $103 750,000 CAA budget This is $135 000 below the Administration recommendation Of the cut, $100 000 was for operation and maintenance of Alaskan airports The $550,000 allowed for this activity is $50,000 more than the $500,000 provided for the current fiscal year The remaining $35,000 was trimmed from the appropriation for administrative expenses in the air navigation and development program, leaving $50,000

The House approved $1 million, the amount requested, for Commerce Department participation in the research and development work of the Air Navigation Development Board

- Approved $40 million to CAB for airline subsidy payments Added to an $8 million carryover, this will permit payments at a rate of $6 million a month until Mar 1, 1955 The Board's request of $73 million for the entire year contemplated payments at this rate

In House debate it was made clear that subsidy requirements beyond Mar 1 will be considered early next year (AVIATION WEEK Mar 8, p 12) Two attempts by Rep John Rooney to reduce the figure to $23 million failed first on an 86 to-40 standing vote and then on a 265 to-105 roll call vote.

- Approved the $3,777,000 asked for CAB operations This is $27,000 more than the Board's current budget to provide for handling of airline subsidies, a task acquired last fall when subsidies were separated from airmail pay

The $103 million provided for CAA is $35 million below this year's $138 million (AVIATION WEEK Mar 1, p 12) Because Administration requests were so low, the House made no further reductions in these CAA estimates

- Salaries and expenses, $96,450,000, compared with about $105 million for the current fiscal year
- Establishment of air navigation facilities, $5 million, compared with $7 million for fiscal 1954
- Technical development, $700 000, compared with $750,000 for 1954

Trip Policies Include Nonskeds, Court Rules

New York State Court of Appeals has ruled that present airline trip insurance contracts purchased from airport vending machines are valid for flights on nonscheduled as well as scheduled carriers.

In a significant test case, the court ordered the Fidelity & Casualty Co. to pay the beneficiary of a passenger killed in a nonscheduled plane crash the principal policy sum of $25,000 although the policy was limited to scheduled airline passengers.

The passenger purchased the policy from a vending machine at Newark Airport for a flight on Miami Airlines, Inc. The plane crashed at Elizabeth, N. J., shortly after takeoff on Dec. 16, 1951.

In a four-to-two ruling, the court held:

- Sign on the vending machine said "airline trip insurance." There was no differentiation between scheduled and nonscheduled.
- Although the policy specifically said the contract applied only to flights on civilian scheduled airlines, this was not spelled out clearly enough. Definition of the term "scheduled" seems to be too technical for the average layman.
- It was not established that a specimen policy was attached to the top of the machine for examination prior to purchase.
- The vending machine was located directly in front of the nonskeds ticket counter at Newark.
- The words "civilian scheduled airline" were not too clear in the policy coverage clause because the statement "This policy is limited to aircraft accidents—read it carefully" was printed in bold lettering across the face of the document, partially covering this portion of the policy.

The dissenting judges held that the courts, as well as Congress and Civil Aeronautics Board, invariably have recognized that the scheduled airline is a definite, well understood class of carrier.

"We do not see how the term 'scheduled' can mean nonscheduled," they stated, and according to law "an insurance company is as free as any other party to limit and condition its liability as it sees fit, so long as there is no statutory provision or rule of public policy to the contrary."

Godfrey Loses Pilot License for 6 Months

Civil Aeronautics Board has suspended Arthur Godfrey's pilot certificate for six months effective this week, ruling that the radio and TV star purposely made a careless takeoff from Teterboro, N. J., airport Jan. 7.

▶ Findings—The Board's three specific reasons for the suspension:

- Flying a Douglas DC-3 "in a manner that did not conform to the traffic pattern prescribed."
- Operating the plane "in such proximity to other aircraft so as to create a collision hazard."
- Flying without an up-to-date medical certificate.

Godfrey comments he has abided by government air regulations in 20 years of flying and will continue to do so. He says he will not appeal the decision. Civil Aeronautics Administration recommended a 30-day suspension.

BOAC Comets Resume Operations This Month

(McGraw-Hill World News)

London—British Overseas Airways Corp. will resume operation of Comet 1s on its London-Johannesburg run Mar. 23.

Modification of the airline's entire fleet of Comets, grounded since Jan. 11 as a result of the crash near Elba (AVIATION WEEK Jan. 18, p. 16), is nearing completion. All other Comet schedules are expected to be resumed shortly.

Decision to place the aircraft back

in operation was announced by the British Minister of Transport A. T. Lennox-Boyd, after consultation with the Air Registration Board, Air Safety Board and BOAC.

► **No Public Inquiry**—Indications are that the decision was painfully difficult in view of the six Comet 1 crashes over the past 15 months. Cause has not been determined in the Elba crash, and to date there has been no public inquiry. Such an inquiry had been promised by Lennox-Boyd.

British officials state, however, that no weaknesses have been brought to light after minute technical investigation of remaining Comets.

More than 50 modifications have been or are being made, officials add, many designed to cope with theoretical causes of the Elba accident and the BOAC crash near Calcutta last May.

► **$1.5-Million Loss**—The decision to resume Comet service indicates that officials believe nothing further is likely to come from current salvage operations off Elba. It may take up to six months before the center section of the aircraft with engines is recovered from the sea.

With the two unexplained crashes, BOAC may be letting itself in for criticism by resuming Comet service, some observers here say, but feeling seems to be that further delay will not answer the baffling crash-cause questions.

Grounding already has cost BOAC almost $1.5 million.

French carriers also plan resumption of Comet service. Air France plans to put its three Comet 1s back in the air by mid-April, while Union Aeromaritime de Transport (UAT) will start flying Paris-Johannesburg this week.

Four Airlines Get Adjusted Mail Rates

Civil Aeronautics Board has adjusted the mail rates of Braniff International Airways, Capital Airlines, Delta C&S Air Lines and Western Air Lines, establishing a permanent rate of 45 cents per ton-mile retroactive to Jan. 1.

The new rate applies for the route segments of these carriers which are directly competitive with other carriers presently operating a final 45-cent rate.

► **Preventive Measure**—CAB says it took this action because of the announced policy of Post Office Department directed to the dispatching of mail over routes of airlines being paid the lowest compensation between any pair of cities. The Board says its action will prevent possible diversion of important mail revenues from Braniff, Capital, Delta and Western.

CAB also set a temporary rate of 53 cents per ton-mile over the remainder of the domestic systems of the four carriers, with provision that this temporary rate will be reviewed at a later date. It would be subject to retroactive adjustment, taking into account the effect of the 45-cent rate on competitive route segments.

Nonsked Proposes Scheduled Shuttle

An exemption to an exemption is asked by North American Airlines in its proposal before Civil Aeronautics Board to initiate shuttle aircoach service between New York and Washington.

The nonscheduled airline proposes to fly DC-4s between the two cities at a $10 one-way fare, $2.77 less than aircoach service now provided by Eastern Air Lines and American Airlines. Tickets would be sold aboard the aircraft without reservation. Carry-on baggage facilities would be provided.

► **Suitability Cited**—In order to approve such service, the Board would have to exempt the nonsked from its present exemption (regulations of the Civil Aeronautics Act permitting operation of nonscheduled service) so it could begin scheduled flights.

The idea for such service was broached last summer by a member of the Board in the belief that an airline such as North American was peculiarly suited for that type service.

► **14-Flight Limit**—Last week the airline also filed a request for reconsideration of its earlier proposal (Aviation Week Mar. 1, p. 64) to dismiss the enforcement proceeding currently under way by the Board.

The company asks that the proposal of two dissenters to CAB's earlier rejection be adopted. This would limit the airline to 14 flights per month between any two terminals as suggested by CAB members Josh Lee and Joseph Adams in their dissent.

The company also asked for postponement of the enforcement hearing scheduled to begin last week in Los Angeles.

ODM Sets Fast Tax Writeoff for New Labs

New research and development laboratory facilities are eligible for fast tax amortization benefits under a ruling by the Office of Defense Mobilization.

The facilities must be used in development of products for which mobilization expansion goals have been set. These include aircraft, aluminum, titanium, cobalt, antimony, copper, molybdenum, nickel.

ODM says the ruling "is designed to recognize further the important place of scientific and technical research in defense mobilization."

New NWA President To Face Internal Fight

The resignation of Harold R. Harris as president and chief executive of Northwest Orient Airlines raises the question of a likely successor who immediately will be faced with the problem of resolving the serious internal problems in the company resulting from differences of opinion among both stockholders and management.

There are reported to be two strong groups of Northwest stockholders in New York and another in Twin Cities, each having different ideas on how the airline should be run. Only unanimity evidenced by these groups in recent months was agreement to replace Harris.

▶ **Bad Spot**—In order to put any kind of progressive management program into operation, Harris' successor must first resolve these differences, gain the confidence of both the board and stockholders.

One observer summed up the situation thus: "Northwest is in a bad spot, and unless the next president is given a free hand, with little or no interference from non-management people having limited knowledge of airline operations, drastic consequences will result."

Indications are that Malcolm MacKay may get the nod to replace Harris. This feeling is strengthened by the fact the board returned MacKay to the executive vice president post which he held prior to Harris' reorganization of the company. Added significance is attached to the fact that MacKay made the announcement of Harris' resignation, while board chairman Croil Hunter had no comment.

▶ **Harris' View**—In tendering his resignation Harris stated that "basic and irreconcilable differences of opinion have developed between myself and a group who presently constitute a majority of the company's board of directors.

"These disagreements, involving the reversal of policies previously approved by the board relate to basic policy underlying the planning for the company's future so that the company may properly discharge its obligations to the public, provide security and expand opportunity to its employes and offer a fair return to its owners."

Harris says his basic policies and program reversed by the board included:

• **Internal reorganization** of the company to define and separate executive and administrative duties in order to free top management from administrative details. This involved moving of Northwest's executive offices to New York from Twin Cities (AVIATION WEEK Nov. 2, 1953, p. 74).

• **Establishing credit** and financial standing to insure the company's survival. Harris pointed out that during the year he actively headed the company, net operating income was $1,277,000 after payment of federal income taxes of $1,501,000. This compares with a net operating income of $693,000 in 1952 after payment of $813,000 in taxes.

Net operating income available for common stock was $1.03 per share in 1953 after payment of $434,000 for preferred dividends, as compared with 31

Short Bros. Produces Canberra Jet Bombers

Silver painted Canberra twin-jet bombers built by Short Bros., Belfast, Northern Ireland, await delivery to RAF Bomber Command. The super-priority Canberra bomber is being built by four different aircraft firms under subcontract. USAF version, the B-57A, is being built by Glenn L. Martin using Wright J65 Sapphire jets.

cents per share after payment of $440,000 for preferred dividends in 1952.

• **A program for acquiring** long range equipment for the future in order that Northwest might remain competitive. Reports indicate that the company will not follow through on its order for five Lockheed Super Constellations

• **Pressing for route renewals** and improvements "necessary for the future welfare of the company and its survival as a major trunkline"

• **Acquiring immediately** a small number of additional pressurized four-engine aircraft

• **Instituting** long-range economic and financial planning

• **Establishing** new maintenance facilities at Twin Cities

Willis Player, vice president for public relations and H Don Reynolds, executive assistant to the president resigned with Harris

Both officials had been appointed by Harris subsequent to his taking office in January 1953

American Realigns Administrative Setup

American Airlines is reorganizing into four major administrative units under a new plan aimed at decentralizing authority in New York and increasing responsibilities of officers in the field

The plan calls for regrouping interrelated departments into one unit under a senior vice president and realigning the duties of officials for better coordination

New senior vice presidents in charge of the four units C R Speers, sales, O M Mosier, operations, W J Hogan, finance and planning and C W Jacob, secretary

▶ **Simple Form"**—American president C R Smith says the realignment plan—drawn up by McKinsey & Co., New York management consultants—provides for a "simple form of organization and one well adapted to the requirements of our business"

The departments are scheduled to be regrouped this month into the following structure

• **Operations** Biggest change is setting up a new customer relations department in this unit to handle passenger and cargo services under the direction of vice president R E S Deichler "This will be a staff department which will establish the policy and standards by which American Airlines will provide services to its customers," Smith says

Other departments under operations and the vice presidents in charge equipment development, M G Beard, maintenance and engineering, Marvin Whitlock, purchasing and stores, G J Brandewiede, and flight, L G Fritz (AVIATION WEEK Mar 1, p 11)

• **Sales** With the transfer of such functions as ticket and reservations offices to customer service, this unit will be able to concentrate on production of additional revenue and increased sales through "more rather than less emphasis on a well planned, hard-hitting sales program," Smith says

Reporting to sales will be the public relations department under vice president Rex Smith

• **Finance and Planning** This unit has taken on the additional responsibility of organizational planning established the office of vice president L E Glasgow to handle all accounting and control and separated these duties from those of treasurer P G Lane

• **Corporate Affairs** Senior vice president Jacobs has assumed duties as secretary and director of this unit, which includes the properties and community department under vice president Walter H Johnson and the Washington office under vice president Carlene Roberts

Separate departments are research, under vice president William Littlewood, who will report directly to Smith, and personnel, directed by vice president G K Griffin

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